

Book of Abstracts
International Conference
**“Waste Management, Environmental Geotechnology
And Global Sustainable Development
ICWMEGGSD’07 – GzO’07”**

August 28-30, 2007
Ljubljana, SLOVENIA

Zbornik povzetkov
mednarodne konference
**“Gospodarjenje z odpadki, okoljska geotehnologija
in trajnostni razvoj - ICWMEGGSD’07”**

in

8. strokovnega posvetovanja
z mednarodno udeležbo

“Gospodarjenje z odpadki GzO’07

-

**minimizacija količin odpadkov
in trajnostni razvoj”**

Editor-in-Chief/Glavni urednik:
Jože KORTNIK

Ljubljana,
28.-30. Veliki srpan 2007

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“Waste Management, Environmental Geotechnology and Global Sustainable Development ICWMEGGSD’07 – GzO’07”, **August 28-30, 2007, Ljubljana, SLOVENIA.**

Zbornik povzetkov mednarodne konference “Gospodarjenje z odpadki, okoljska geotehnologija in trajnostni razvoj ICWMEGGSD’07 – GzO’07”, **28-30. Avgust, Ljubljana.**

Editor-in-Chief/Glavni urednik:

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Ljubljana, 28.-30. avgust 2007

THE WASTE MANAGEMENT, ENVIRONMENTAL GEOTECHNOLOGY AND GLOBAL
SUSTAINABLE DEVELOPMENT CHALLENGE - AN EDITORIAL

As.Prof. Jože KORTNIK
Chair, ICWMEGGSD'07 – GzO'07

Foreword

21st century will be characterized by an increased concern on environment issues and by growing awareness, that we are straining the environment. This will be a century of increasing convergence of issues, approaches and disciplines of sustainable development across national frontiers. Major environmental quality and economic development issues such as global warming, environmental pollution (water, air and soil), desertification, excessive waste generation, transcontinental transport of dust and disease vectors have both local and global drivers and effects. The challenges that we face are many and require careful analyses and establishment of appropriate balances among environmental quality, economic development for provision of goods and services, and social equity.

In this International Conference on Waste Management, Environmental Geotechnology and Global Sustainable Development held at Grand hotel Union in Ljubljana, Slovenia, from August 28-30, 2007, the above stated concerns are matter of discussion. A forum to exchange ideas and informations on recent relevant development of waste management, environmental geotechnology and sustainable development is provided through 14 technical sessions, 4 keynote speeches and 3 technical visits in order that educators, researchers and practitioners achieve a proper perspective of the environmental and sustainable development situation.

This volume contains 105 paper abstracts of 228 authors and coauthors, representing the contribution of 16 countries have been submitted (Asia (40), Europe (43), America (9) and Africa (13) papers). From this initial amount, 76 papers have been selected for CD publication by the Conference Reviewer Committee.

It is also important to point out, that this Conference offered a great opportunity to asses where each of the above subjects stands today and to delineate the necessary essential step for having a successful future life in our common planet Earth.

Finally, on behalf of the Organizing Committee I would like to convey a warm welcome to all delegates, and I hope that

foreign delegates will use this opportunity to enjoy the beauty and diversity of Slovenia.

Acknowledgements

To organize a Conference of this magnitude is not a simple task and needs the contribution of many individuals, yet it is difficult to identify everyone who contributed to its success. However, an attempt is made to recognize organizations and individuals contributions. The Organizing Committee would like to gratefully acknowledge the financial support of the Institute IRGO, RIKO, Velenje Coal Mine, Trbovlje-Hrastnik Coal Mine, Geological Survey of Slovenia, HSE Group, ECONO, Geodetski zavod Celje, Slovenian Chamber of Engineers and KOSTAK.

We would like to thank for hosting Faculty of Natural Sciences and Engineering and Institute IRGO, RS Ministry for Environment and Spatial Planning, International Society for Environmental Geotechnology ISEG, Society SRDIT and Municipality of Ljubljana. The success of Conference would not have been possible without the contribution of all participants. We extend our appreciation to all Keynote speakers, and to those who participate in the presentations, discussions, group meetings, technical visits and provided inputs for this Conference. We extend our appreciation also to the International and Local Scientific Committee who played an important role in selecting the papers for this event.

We are thankful to the companies SNAGA, Žirovski vrh Uranium Mine and Velenje Coal Mine for the technical visits arrangements.

Finally, I thankful to prof. Uroš BAJŽELJ, prof. Hilary I. INYANG, dr. Jouko SAARELA, Prof. Terezinha Cássia de Brito GALVÃO and dr. Sue STRUTHERS for theirs continued support in the organization of the Conference.

Without these and numerous other individual efforts it would not have been possible to put together this extensive conference program.

Jože KORTNIK
Chairman,
ICWMEGGSD'07 – GzO'07

doc.dr. Jože KORTNIK
Predsednik, ICWMEGGSD'07 – GzO'07

Uvodna beseda

Za 21. stoletje bo zaradi čedalje večjega obremenjevanja okolja značilna znatno večja skrb za vsa okoljska vprašanja. To bo stoletje neizogibnega mednarodnega poenotenja različnih pogledov, stališč in pristopov pri reševanju različnih okoljskih problemov ter povezovanja različnih strokovnjakov v okviru mednarodnega trajnostnega razvoja. Glavna vprašanja glede kvalitete okolja ter nadaljnim ekonomskim razvojem družbe so vse bolj povezana z globalnim segrevanjem ozračja, intenzivnejšim onesnaževanjem okolja (vode, zraka in tal), širjenjem puščav, naraščanja količin odpadkov, medkontinentalnega transporta nevarnih snovi in bolezni, ki nimajo samo lokalih ampak vse večje globalne učinke in posledice. Izzivi s katerimi se soočamo so številni, zahtevajo podrobno analizo in uravnoteženo odločanje (izbiri) med kvaliteto okolja ter ekonomskim razvojem (količino dobrin, kvaliteto uslug in socialnim razvojem družbe).

Na mednarodni konferenci Gospodarjenje z odpadki, okoljska geotehnologija in trajnostni razvoj, ki bo potekal v Grand hotelu Union v Ljubljana, od 28.-30. avgusta 2007, bodo v številnih predstavitev in razpravah obravnavani predhodno navedeni izivi. Za izmenjavo idej, mnenj in izkušenj glede stanja in možnosti nadaljnega na področju gospodarjenja z odpadki, okoljske geotehnologije in trajnostnega razvoja bo na voljo 14 tehničnih sekcij, 4 svečana predavanja in 3 strokovne ekskurzije.

Zbornik povzetkov obsega 105 povzetkov člankov preko 228 avtorjev in soavtorjev, kar predstavlja prispevke iz kar 16 različnih držav sveta (Azije (40), Evrope (43), Amerike (9) in Afrika (13) papers). Od tega je recenzijska komisija za objavo na zgoščenki (CD) izbrala 76 člankov.

Prav tako je pomembno poudariti, da mednarodna konferenca ponuja veliko možnosti za oceno današnjega stanja predhodno poudarjenih problemov in za načrtovanje in izvajanje nadaljnjih potrebnih ukrepov za zagotavljanje življenja na našem skupnem planetu Zemlji.

Na koncu bi se želel v imenu organizacijskega odbora toplo zahvaliti vsem udeležencem. Še posebej toplo gostom iz tujine katerim želim, da med nami lepo počutijo in to priložnost izkoristijo tudi za ogled številnih naravnih lepotah Slovenije.

Zahvale

Organizirati tako veliko in pomembno mednarodno konferenco ni preprosta naloga in zahteva predano delo številnih posameznikov, ki jih je težko vse naštet. Kljub temu lahko izpostavim nekaj posameznih organizacij, podjetij in posameznikov, ki so pomembno pripomogli k uspešni organizaciji in izvedbi conference. V imenu organizacijskega odbora se za finančno pomoč zahvaljujemo inštitutu IRGO, podjetjem RIKO, Premogovniku Velenje, Rudniku Trbovlje-Hrastnik, Geološkemu zavodu Slovenje, Holdingu Slovenske elektrarne, ECONO, Geodetskemu zavodu Celje, Inženirski zbornici Slovenije in KOSTAK.

Za pokroviteljstvo nad konferenco se želim zahvaliti Naravoslovnotehniški fakulteti, Oddelku za geotehnologijo in rudarstvo in inštitutu IRGO, Ministrstvu za okolje in prostor, International Societyfor Environmental Geotechnology ISEG, društvu SRDIT in Mestni občini Ljubljana. Zahvalo za uspešno konferenco dolgujem tudi vsem Vam, ki ste pripravili prispevke in predavanja, sodelovali na razpravah, srečanjih, strokovnih ekskurzijah in vsem, ki ste kakor-koli sodelovali na konferenci. Prav tako bi se želel zahvaliti mednarodnemu in domačemu znanstvenemu pri izbiri člankov in še posebej vsem članom organizacijskega odbora GzO.

Za organizacijo in izvedbo strokovnih ekskurzij se zahvaljujem podjetjem SNAGA, Rudniku Žirovski vrh v zapiranju in Premogovniku Velenje.

Na koncu bi se želel zahvaliti prof.dr. Urošu BAJŽLJU, prof.dr. Hilary I. INYANGU, dr. Jouko SAARELI, Prof.dr. Terezinha Cássia de Brito GALVÃO in dr. Sue STRUTHERS za njihovo nesebično pomoč z nasveti in moralno podporo.

Brez prispevka le-teh in številnih drugih, nam nebi uspelo pripraviti tako raznoliklega in bogatega konferenčnega programa. Hvala vam.

Jože KORTNIK
Predsednik,
ICWMEGGSD'07 – GzO'07

ICWMEGGSD'07-GzO'07 CONFERENCE LEADERSHIP/ PREDSEDSTVO (ICWMEGGSD'07-GzO'07) KONFERENCE

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Predsednik konference:

- **As.Prof. Jože KORTNIK**, University of Ljubljana, Slovenia

Conference Co-Chairs:

Predsedniki tematskih področij:

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- **Prof. Hilary I. INYANG**, University of North Carolina, USA
- **Prof. T. Cássia de Brito GALVÃO**, Spelman College, Atlanta, GA, USA.

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GzO'07 Organizing Committee:

Organizacijski odbor GzO'07:

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- **Mrs. Milka LESKOŠEK**, Javne naprave, Celje
- **Mr. Jože LESKOVAR**, KOSTAK, Krško

CONFERENCE PROGRAM OVERVIEW / POVZETEK KONFERENČNEGA PROGRAMA

Monday, August 27, 2007

- 9.00–13.00 **Pre-Conference Workshop: Design, Analysis and Management of Landfills**, Hilary I. INYANG
(Venue: lecture room P-5, Faculty of Natural Sciences and Engineering, Aškerčeva 12, Ljubljana)
Delavnica: Design, Analysis and Management of Landfills, Hilary I. INYANG
(lokacija: predavalnica P-5 Naravoslovnotehniška fakulteta, Aškerčeva 12, Ljubljana)
- 17.00–19.00 **Pre-Conference welcome drink reception and early registration**
(Venue: Grand hotel Union (GHU), Garden Hall)
Sprejem udeležencev (lokacija: Grand hotel Union (GHU), Steklena dvorana)

Day 1. Tuesday, August 28, 2007 ICWMEGGSD'07

Dan 1. Torek, 28. Avgust 2007 ICWMEGGSD'07

- 8.30– 9.00 **Registration and Welcome Coffee** (Venue: GHU, Grand Foyer)
Prijava udeležencev in pozdravna kavica (lokacija: GHU, Preddverje)
- 9.00–10.30 **Opening Ceremony ICWMEGGSD'07 – GzO'07** (Venue: GHU, Union Hall)
Svečana otvoritev ICWMEGGSD'07 – GzO'07 (lokacija: GHU, Unionska dvorana)
- 10.30–11.00 **Press Conference** (Venue: GHU, White Hall)
Novinarska konferenca (lokacija: GHU, Bela dvorana)
- 10.30–12.00 **Keynote Presentations** (Venue: GHU, Union Hall)
Svečana predavanja (lokacija: GHU, Unionska dvorana)
- 12.00–13.00 **Lunch Break** (Venue: GHU Restaurant)
Kosilo hladno-topli bife (lokacija: GHU Restavracija)
- 13.00–15.00 **Session 1.: GLOBAL SUSTAINABLE DEVELOPMENT** (Venue: GHU, Union Hall)
Sekcija 1.: TRAJNOSTNI RAZVOJ (lokacija: GHU, Unionska dvorana)
- 13.00–15.00 **Session 2.: ENVIRONMENTAL GEOTECHNOLOGY** (Venue: GHU, White Hall)
Sekcija 2.: OKOLJSKA GEOTEHNOLOGIJA (lokacija: GHU, Bela dvorana)
- 15.00–15.20 **Coffee Break** (Venue: GHU, Grand Foyer)
Odmor (lokacija: GHU, Preddverje)
- 15.20–17.00 **Session 3.: ENVIRONMENTAL GEOTECHNOLOGY** (Venue: GHU, Union Hall)
Sekcija 3.: OKOLJSKA GEOTEHNOLOGIJA (lokacija: GHU, Unionska dvorana)
- 15.20–17.00 **Session 4.: ENVIRONMENTAL GEOTECHNOLOGY** (Venue: GHU, White Hall)
Sekcija 4.: OKOLJSKA GEOTEHNOLOGIJA (lokacija: GHU, Bela dvorana)

Day 2. Wednesday, August 29, 2007 GzO'07

Dan 2. Sreda, 29. Avgust 2007 GzO'07

- 8.30– 9.00 **Registration and Welcome Coffee** (Venue: GHU, Grand Foyer)
Prijava udeležencev in pozdravna kavica (lokacija: GHU, Preddverje)
- 9.00–11.00 **Session 5.: WASTE MANAGEMENT – GzO'07** (Venue: GHU, Union Hall)
Sekcija 5.: GOSPODARJENJE Z ODPADKI – GzO'07 (lokacija: GHU, Unionska dvorana)
- 9.00–11.00 **Session 6.: WASTE MANAGEMENT – GzO'07** (Venue: GHU, White Hall)
Sekcija 6.: GOSPODARJENJE Z ODPADKI – GzO'07 (lokacija: GHU, Bela dvorana)
- 11.00–11.20 **Coffee Break** (Venue: GHU, Union Hall)
Odmor (lokacija: GHU, Preddverje)
- 11.20–13.00 **Session 7.: WASTE MANAGEMENT – GzO'07** (Venue: GHU, Union Hall)
Sekcija 7.: GOSPODARJENJE Z ODPADKI – GzO'07 (lokacija: GHU, Unionska dvorana)
- 11.20–13.00 **Session 8.: WASTE MANAGEMENT – GzO'07** (Venue: GHU, White Hall)
Sekcija 8.: GOSPODARJENJE Z ODPADKI – GzO'07 (lokacija: GHU, Bela dvorana)
- 13.00–14.00 **Lunch Break** (Venue: GHU Restaurant)
Kosilo hladno-topli bife (lokacija: GHU Restavracija)
- 14.00–16.00 **Session 9.: WASTE MANAGEMENT – GzO'07** (Venue: GHU, Union Hall)
Sekcija 9.: GOSPODARJENJE Z ODPADKI – GzO'07 (lokacija: GHU, Unionska dvorana)
- 14.00–16.00 **Session 10.: WASTE MANAGEMENT – GzO'07** (Venue: GHU, White Hall)
Sekcija 10.: GOSPODARJENJE Z ODPADKI – GzO'07 (lokacija: GHU, Bela dvorana)
- 16.15–18.30 **TECHNICAL VISIT 1.: Municipal Solid Waste Landfill Barje**
STROKOVNA EKSKURZIJA 1.: Odlagališče nenevarnih odpadkov Barje
- 16.15–16.30 **Meeting and organizing transport by buses to the Municipal Solid Waste Landfill Barje**
(Venue: GHU, Reception Desk)

Zbor udeležencev in organiziran prevoz do odlagališča nenevarnih odpadkov Barje

(lokacija: GHU, Preddverje)

- 16.30–18.00 **Introduction and technical visit of the Municipal Solid Waste Landfill Barje**
Predstavitve in strokovno voden ogled odlagališča nenevarnih odpadkov Barje
Technical leader/Strokovni vodja: mag. Mitja PRAZNIK, MSc.
- 18.00–18.30 **Return to the Grand hotel Union, Ljubljana**
Povratek v Grand hotel Union
- 19.15–24.00 Conference dinner with dance** *(Venue: GHU, Union Hall)*
Svečana konferenčna večerja s plesom *(lokacija: GHU, Unionska dvorana)*
- 19.00–19.30 **Welcome in National Costume** *(appetiser drink)*
Sprejem v narodnih nošah *(aperitiv)*
- 19.30–20.30 **Cultural Programme and Dinner Speeches**
Kulturni program pred konferenčno večerjo
- 20.30–21.30 **Conference Dinner/ Konferenčna večerja**
- 21.30–24.00 **Conference Dance/ Konferenčni ples** *(ansambel Victory)*

Day 3. Thursday, August 30, 2007 ICWMEGGSD'07

Dan 3. Četrtek, 30. Avgust 2007 ICWMEGGSD'07

- 8.30– 9.00 **Registration and Welcome Coffee** *(Venue: GHU, Grand Foyer)*
Prijava udeležencev in pozdravna kavica *(lokacija: GHU, Preddverje)*
- 9.00–11.00 **Session 11.: ENVIRONMENTAL GEOTECHNOLOGY** *(Venue: GHU, Union Hall)*
Sekcija 11.: OKOLJSKA GEOTEHNOLOGIJA *(lokacija: GHU, Unionska dvorana)*
- 9.00–11.00 **Session 12.: ENVIRONMENTAL GEOTECHNOLOGY** *(Venue: GHU, White Hall)*
Sekcija 12.: OKOLJSKA GEOTEHNOLOGIJA *(lokacija: GHU, Bela dvorana)*
- 11.00–11.20 **Coffee Break** *(Venue: GHU, Union Hall)*
Odmor *(lokacija: GHU, Preddverje)*
- 11.20–13.00 **Session 13.: ENVIRONMENTAL GEOTECHNOLOGY** *(Venue: GHU, Union Hall)*
Sekcija 13.: OKOLJSKA GEOTEHNOLOGIJA *(lokacija: GHU, Unionska dvorana)*
- 11.20–13.00 **Session 14.: ENVIRONMENTAL GEOTECHNOLOGY** *(Venue: GHU, White Hall)*
Sekcija 14.: OKOLJSKA GEOTEHNOLOGIJA *(lokacija: GHU, Bela dvorana)*
- 13.00–14.00 **Lunch Break** *(Venue: GHU Restaurant)*
Kosilo hladno-topli bife *(lokacija: GHU Restavracija)*
- 14.00–15.00 Closing Ceremony ICWMEGGSD'07 – GzO'07** *(Venue: GHU, Union Hall)*
Svečani zaključek ICWMEGGSD'07 – GzO'07 *(lokacija: GHU, Unionska dvorana)*
- 15.15–18.30 TECHNICAL VISIT 2.: Uranium Mine Žirovski vrh**
STROKOVNA EKSKURZIJA 2.: Rudnik Urana Žirovski vrh
- 15.00–15.15 **Meeting and organizing transport by buses to the Uranium Mine Žirovski vrh**
(Venue: GHU, Reception Desk)
Zbor udeležencev in organiziran prevoz do Rudnika Urana Žirovski vrh
(lokacija: GHU Preddverje)
- 16.15–18.00 **Introduction and technical visit of the Uranium Mine Žirovski vrh Recultivation Works**
Predstavitve in strokovno voden ogled zapiranja Rudnika Urana Žirovski vrh
Technical leader/Strokovni vodja: mag. Franc AVBERŠEK, MSc.
- 19.30 **Return to the Grand hotel Union, Ljubljana**
Povratek v Grand hotel Union

Day 4. Friday, August 31, 2007 ICWMEGGSD'07

Dan 4. Petek, 31. Avgust 2007 ICWMEGGSD'07

- 8.15–18.30 TECHNICAL VISIT 3.: Velenje Coal Mine**
STROKOVNA EKSKURZIJA 3.: Premogovnik Velenje
- 8.15– 8.30 **Meeting and organizing transport by buses to the Velenje** *(Venue: GHU, Reception Desk)*
Zbor udeležencev in organiziran prevoz v Velenje *(lokacija: GHU, Preddverje)*
- 9.30–13.00 **Introduction and visit of the Velenje Coal Mine Surface Recultivation Works**
Predstavitve in strokovno voden ogled sanacije površine Premogovnika Velenje
Technical leader/Strokovni vodja: mag. Marjan KOLENC, MSc.
- 13.00–14.00 **Lunch** *(Venue: Restaurant Jezero, Velenje)*
Kosilo *(lokacija: Restavracija Jezero, Velenje)*
- 14.00–16.00 **Visit of Coal Mining Museum of Slovenia**
Ogled Muzeja Premogovništva Slovenije
- 18.00 **Return to the Grand hotel Union, Ljubljana**
Povratek v Grand hotel Union

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A. SUSTAINABLE DEVELOPMENT & ENVIRONMENTAL GEOTECHNOLOGY/ OKOLJSKA GEOTEHNOLOGIJA & TRAJNOSTNI RAZVOJ - ICWMEGGSD'07

(ID 104) Preseganje izzivov energetike v prihodnosti: Diverzifikacija energetskega virov in tehnologij

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Evropska unija se sooča s številnimi izzivi na energetskega področju, ki posegajo tudi v trajnostni razvoj – naraščajoča uvozna odvisnost, nujnost precejšnjih naložb in neobstoje resnično konkurenčnega energetskega trga. Sprejela je tako zakonodajne akte kot neobvezujoča priporočila, a ne zadoščajo. Nedavna Zelena knjiga kot cilj izpostavlja uravnoteženje trajnostnega razvoja, konkurenčnosti in varnosti oskrbe, pri tem pa poudarja diverzifikacijo energetske mešanice kot eno ključnih področij, kjer so potrebni dodatni ukrepi, da bi Evropa lahko dosegla ta cilj. Pri tem bodo ključno vlogo igrali zakonodajni ukrepi in programi za energetske učinkovitost ter spodbude za konkurenčne in učinkovite obnovljive vire energije. Ukrepi glede obnovljivih virov energije in energetske učinkovitosti bodo poleg boja proti podnebnim spremembam prispevali k varnosti oskrbe z energijo in pomagali omejiti našo naraščajočo uvožno odvisnost.

Diverzifikacija na ravni dobave in povpraševanja oz. uporaba vseh primernih obstoječih tehnologij pa je tudi ključno priporočilo, ki izhaja iz nedavnega projekta organizacije Eurelectric z naslovom Vloga električne energije, kjer so izdelali štiri različne scenarije prihodnjega razvoja energetike in njihovih posledic. Kot najbolj vzdržen scenarij se je izkazal prav tisti, ki je vključeval ukrepe na področju energetske učinkovitosti, obnovljivih virov energije, jedrske energije, ter tehnologij CCS in poudarja razvoj vseh obstoječih virov energije s primernimi in naprednimi tehnologijami. S tem dosežemo najbolj vzdržne

rezultate tako na področju varnosti dobave in konkurenčnosti, kot tudi na področju klimatskih sprememb. Kot kaže primer Nemčije, ki je eden glavnih akterjev pri oblikovanju globalne energetske politike, bi posledice njenega razmišljanja, da se morda odpove eni od obstoječih tehnologij in postopoma ukine jedrsko energijo, lahko pomembno posegle v krhko ravnovesje med varnostjo dobave, ekonomsko učinkovitostjo in trajnostnim razvojem. HSE, ena od vodilnih slovenskih družb na področju energetike, se zato močno zaveda pomena ohranjanja tega ravnotežja in skuša vzpostaviti optimalno diverzifikacijo energetskega virov. Z dobavo električne energije, ki vključuje kombinacijo različnih virov, je strategija HSE, ki bo predstavljena kot primer uporabe tega uravnoveženega pristopa, igrati ključno vlogo pri zagotavljanju varne, zanesljive, konkurenčne in okolju prijazne oskrbe domačih in tujih odjemalcev.

(ID 104) Overcoming Energy Challenges in the Future: Diversification of Energy Sources and Technologies

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The European Union is facing major challenges in the energy field that are taking its toll on sustainable development as well - growing import dependency, the need for substantial investment and lack of competitive energy market. It has adopted binding legislation and non-binding recommendations, but they do not suffice. The latest Green paper identifies the goal of balancing sustainable development, competitiveness and security of supply and stresses the diversification of energy mix as one of the key areas, where further action is needed, if Europe is to achieve this goal. The key role in this process will be played by legislative initiatives and energy efficiency programmes with encouragement to competitive and effective renewable energy. Action on renewable energy sources and energy efficiency, besides tackling climate change, will contribute to security of energy supply and help limit our growing import

dependence.

Diversification in the field of supply and of demand, namely the use of all available options and technologies, is also a key recommendation, delivered by a recent Eurelectric project Role of electricity, where four different scenarios of future development in the energy field and their consequences were investigated. The scenario that proves to be the most sustainable is the one that envisages the use of all options – energy efficiency, renewables, nuclear energy and CCS technologies and stresses the development of all energy sources with appropriate and advanced technologies. This will enable sustainable results in the field of security of supply and competitiveness as well as in the field of climate change. As the case of Germany, one of the countries that has a major impact on global energy policy, clearly shows – the consequences of its consideration to possibly abandon one of the available options and carry out a progressive nuclear phase-out could significantly interfere with the fragile balance of energy security, economic efficiency and environmental sustainability. For such reasons, HSE, one of the leading Slovenian companies in the power sector, is strongly aware of the importance of maintaining this balance and developing an optimal diversification of energy sources. Through the supply of electricity stemming from the mix of different sources, HSE's strategy, which will be examined as an example of application of this balanced approach, is to play a key part in ensuring secure, reliable, competitive and environmentally friendly supply to domestic and foreign customers.

(ID 013) A Pragmatic Inquiry into the next World Summit of Sustainable Development Targeting Options Related to Sanitation and Poverty Reduction

- **Manfred FEHR**, *Federal University at Uberlândia, Uberlândia, Minas Gerais, BRAZIL.*
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The World Summit on Sustainable Development of 2002 quantified targets and fixed time frames for many topics relevant to sustainable urban development. The present study addresses the question asked by local administrators on what exactly has to be achieved

every year to reach the targets. There are flow problems and storage problems. This study singles out one example of each for analysis. Urban sanitation, of which waste management is an integral part, is representative of flow problems, which are those that can be solved quite rapidly with appropriate technology and financial support. Poverty eradication is representative of storage problems, which are those that require depletion of an existing stock. The directive was to halve, by 2015, the proportion of the World's people who live on less than one dollar per day and have no access to basic sanitation. The resource arithmetic presented here moves beyond the year of 2015 and evaluates the targeting options of the next Summit. It is concluded that both the flow and the storage problem may be solved within approximately 13 years after the 2012 Summit if presently valid annual sanitation service expansion factors and annual poverty contraction factors were maintained. For shorter time allowances, significantly sharper targets would have to be set by the next Summit.

(ID 071) Waste Management as Part of Resource Management within the Context of Sustainability

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Sustainable development became the prevailing policy paradigm by the turn of the millennium. Human activities should be conducted according to sustainability principles so as to further progress toward the goals of economic prosperity, environmental health, and social equity. Views on how these goals are envisioned and how they could be achieved differ within societies and across nations. Fortunately the principles are flexible and can be interpreted in different ways. As applied to minerals, the main goals of sustainable resource management are to maintain the stream of benefits to society and to do so in a manner that results in a net benefit to society over the

life of the mine and the product. The aim of waste management is to mitigate all the undesired impacts waste, or, in other words, turn wastes to non-wastes. The aim of this paper is to demonstrate that some core concepts used in sustainable resource management can be applied also to waste management and vice versa. In doing so, resources and wastes can be more integrated, and not separated as desired or undesired outcomes of the production process. Resource and waste management intersect in particular in mining and construction activities.

Session 1. Global Sustainable Development **Sekcija 1. Trajnostni razvoj**

(ID 045) Study on the Relation Between the Capitalized Resources Management and Mine Environment or Resources Protection

- **Ying-hong WANG**, *China University of Mining and Technology, Jiangsu, CHINA.*

At first, an example is given to explain that the resource economy evaluation method which the capital time value is taken into account results in favor of the project exploiting profitability coal resources prior. Based on this, the standard of protecting inferior coal resources has been put forward. Then, the theory and method for evaluation of coal resource value and environment damage are analyzed. A method for economically feasibility evaluation of coal resources taking the values of coal resource and environment impact into consideration is brought forward, and compared with the traditional method. The result shows that the fundamental factors for the resource protection during coal mining are to make the rationality of the income difference between inferior coal mining and high-grade coal mining, and the rationality of coal products price. The conclusion which the capitalized resource management will be more suitable to coal resource protection has been testified in theory. However, it should be pointed out emphatically that the capitalized resource management could not substitute normal resource management in coal exploitation and mining. At the same time,

the effect and insufficiency on protection of mining environment and resources about the Chinese system of mining tax have been analyzed, some betterment advice have been given, too.

(ID 074) Mining and Environment: Bangladesh Perspective

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There are major mine able deposits of coal, limestone and granite in Bangladesh. These are often at a deeper depth than conventionally exploited elsewhere. However, lack of surface or shallower deposits and overall competitiveness against import has encouraged development of underground mines to exploit such resources. At present two major coalmines are being developed to extract, about 1 million tons of coal and 1.65 million tons of granite respectively from the Barapukuria Coal and Madhyapara Hard Rock Mine.

Other than coal, rock and stone, the gas and oil mining taken an extensive shape in Bangladesh particularly the gas mining is massive. Estimated gas reserves range from 182 billion to 623 billion cubic meters. Deposits lie in more than a dozen different locations, six of which are producing in full swing. Currently, about 90 per cent of power generation is based on natural gas and the whole of the urea fertilizer requirements of the agricultural sector is met by using gas as feedstock. Natural gas output now accounts for about 70 per cent of the country's commercial energy supply.

Mining Accident: An immense fire at the Magurchhara (Maulvi Bazar district) gas field in June 1997 from an explosion devastated a large part of the forest and several tea gardens in the gas field vicinity. Many wild animals and tiny creatures living in the forest had been burnt dead while many others had been suffocated in the poisonous gas. A cluster village of the forest dwelling khasi people, had suffered environmental and economic loss. The fire had damaged many houses on the hillocks and destroyed 20,000 Betel creepers of 150 acres of land. The unprecedented fire, which could be stopped only after several months, proves the fragile position of Bangladesh in exploring and controlling the mineral resources.

(ID 091) Sustainable Water Developments

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Sustainable development presumes fair and equal social and economic development while protecting the long-term carrying capacity of the life support system. Water plays fundamental roles for sustain ability in each of these three areas indisputable at least to water professionals! Without access to clean and adequate amounts of water resources, there cannot be any social development and likewise no long-term economic development. The role of water for the overall health of the environment is obvious. Water management issues continue to be dealt with in a fragmented and rudimentary manner, dominated by sectorial perspectives and neglecting the role of the water cycle as the bloodstream of the biosphere as a whole. Water management tends to be seen as linked to human health rather than the total well-being of humans, as a cheap resource to be used by industry and agriculture rather than the ultimate resource for any economic development to take place, or as the specific component of the life support system rather than the fundametal resource for all living organisms. Moreover, water professionals tend to remain isolated from the key actors that set the agenda for development. Economic social and environmental policies often contain very little on the role of water.

LINKAGES BETWEEN FLOOD RISKS AND LAND USE CHANGE

Growth of cities and industrialization bring significant change in physical properties of land surface, influencing the river flow regime. As the area of impermeable surface increases, infiltration decreases and surface runoff accelerates, bring flood risks, riverbank erosion, sediment transport and pollution downstream. Intensive agriculture and deforestation may also accelerate runoff formation, increases sediment transport and chemical pollution in the river. Temporary storage or water in dams may constitute an important source of water for water supply and irrigation, mitigating seasonal variations in water availability. Flooding in a river basin may bring disastrous effects and destroy human constructions and agricultural land, but it may also contribute in increasing soil fertility by deposition of mud. River regulations and flood mitigation strategies may constitute useful tools for a wise river basin management. There is a large family of measures giving possibility to

manipulate urban and rural river flows and mitigate flood risks. Besides dam construction, here belong many methods of increasing surface storage, evaporation, infiltration and percolation to ground water. It is also possible, and sometimes desired, to store excess runoff temporarily, by for example, diverting excess flow to other streams, natural or artificial ponds, lakes and wetlands.

WATER FOR FOOD AND ENVIRONMENTAL SECURITY

On the one hand, the fundamental tear of food shortages encourages ever greater use of water resources for agriculture. On the other, there is a need to divert water from irrigated food production to other users and to protect the resource and the ecosystem. Many believe this conflict is one of the most critical problems to be tackled in the early 21st century.

The possible trade-off in transferring water from nature to agriculture and vice-versa. As more and more basins are experiencing critical water shortages, the pressure to develop the remaining resources will grow or remain high. At the same time the increasing awareness of the impacts or taking water out of nature, and possibly undermining the resource base, is growing too. Many are convinced that transferring water out of agriculture is the only feasible solution. How can we achieve food and environmental security? Healthy people and a healthy environment?

(ID 003) Waste Management in National Planning (I-O-W) Model a New Paradigm

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Input-output modeling is in vogue on the National Accounting scene. Detailed input-output tables are available for planning of National/Global system. A system is conceptualized to be a set of interactions of the three basic parameters viz Input (I) Output (O)

and Waste (W). In the conventional input/output modeling and proper attention has not been given to the Waste parameter. It is advocated that Waste parameters deserve explicit consideration in view of their vital role in various systems by taking into account consideration the crises of vitally needed resources balanced economic growth. Basic framework of a generalized I-O-W (Input-Output-Waste) model has been propounded with an illustrative example. In this study an attempt is made to develop a new paradigm of National consistency modeling to incorporate WM aspects in National Planning and the awareness for a cleaner and hygienic environment.

(ID 072) PSInSAR Data Analysis – An Insight into Active Tectonics and Mass Movements in West Slovenia

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Using relatively new method called PSInSAR (Permanent Scatterer interferometry) technique active tectonics and slope mass movements in the area that spreads over 700 km² and lies in the NW part of Slovenia were assessed. The research area forms the eastern flank of the Alpine arch and is tectonically still active. For the analytical purposes 57 images of descending orbit from satellites ERS 1 and ERS 2 were used. The time span of the acquired images was from April 1992 to December 2000. The average signal reflector (PS) density for the area was 23 per km². Altogether 16304 permanent scatters were detected. For the best 10 % (1646 PS), time series of displacements were acquired. The results also show a constant uplift of Alps and they indicate that the uplift is of higher magnitude than it was considered until now. The relative uplift in relation to the reference point in the Alpine foreland ranges up to 3.35 mm per year. Several landslide sites were examined and their movements analysed in relation to triggering factors.

(ID 108) The Development of Technology for Removing Debris,

Suspended Material and Sediment from Water, before Storage Dam

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The Ministry of the Economy, Directorate for Entrepreneurship and Competitiveness (MG) published an official notice for the acquisition of resources from the European Regional Development Fund (ERDF), measure 1.1.: Stimulation of Development of Innovation Environment for Direct Stimulation of Common Developed-Investment Projects in year 2006 and 2007 (Official Gazette of the RS no.33-34/2006, 31 March 2006).

At Kostak d.d. we made an application according to the above mentioned notice for the project The development of technology for removing debris, suspended material and sediment from water, before storage dam.

In this project we are cooperating with the following partners:

Project carrier: Kostak komunalno stavbno podjetje d.d.

Partner: Timi Krško gradbeništvo d.o.o.

Knowledge institution: The University of Maribor, Faculty of Civil Engineering

Knowledge institution – mediator: Technology centre Posavje d.o.o.

In this project we have developed technology for removing and treating water to remove debris, suspended materials and sediment from water before storage dam. A starting point of this project is to carry out the construction of a new hydroelectric power station on the lower Sava River, preserving the Sava River.

Both of our companies are concerned with caring for the environment and the pursuit of water quality in the construction projects that we are involved with.

The project focuses on the development of the technology for removing debris and suspended solids from the water and cleaning sediment from the water tanks before hydroelectric power stations, plus the development of further processes to recycle those wastes.

The purpose of this project is to give the theoretical and technical solutions and methods to enable a continual procedure for removing debris, suspended materials and sediments from the water, before it is stored at hydroelectric powers

stations on the lower Sava River. The result of this project will be the use of natural resources, the introduction of a new technology and the development of processes that will achieve environmental goals, and will enhance the personal and market strengths of business partners, educational establishments and mediators. We have formed a consortium between the partners involved in this project and all obligations are defined according to set aims and duties.

We propose to achieve the following goals:

- to develop a technology for removing debris, suspended materials and sediment from water before storage dam,
- to market a new service using this technology for cleaning lakes,
- to use products that are kind to the environment and are competitive and marketable,
- to create an innovative procedure through the execution of this service,
- to reduce unemployment and raise productivity,
- to create new business partnerships through this project and develop new services.

In addition to the above stated aims we will also pursue:

- regional development,
- environmental protection and the use of natural resources in removing water impurities and sediments,
- development of an information source within the company.

Strategic aims of the project to achieve the proposed results by the project conclusion

- preserve or increase in the number of employees,
- improve the knowledge base of the employees,
- increase of the value of employees whose posts will be preserved by this project,
- environmental protection.

The project work for this research and development project Technology development for removing debris, suspended materials and sediment from water, before storage dam includes the above mentioned activities from all the partners included in this project – Kostak Krško d.d. and Timi d.o.o., Faculty of Civil Engineering and Technology centre Posavje.

We have divided the activities in this project into two basic groups:

- carrying out of development activities and research for removing debris and suspended materials from water,
- investments in suitable equipment for removing and treating debris, suspended materials and sediment, before water storage.

We separate those two activities into three time periods:

- Phase 1: from 15 May 2006 – 31 October 2006 (or 31 January 2007)
 - Selection of planned development methods and suppliers,
- Phase 2: from 1 November 2006 (or 01 February 2007) – 31 May 2007
 - Execution of technology for removing debris, suspended materials and sediment from water, before storage dam,
- Phase 3: from 01 June 2007 – 31 December 2007 (15 September 2007)
 - Evaluation of development activities and introduction of improvements.

In addition to the set project aims we would like to achieve a good cooperation and an effective and interactive transfer of knowledge and experiences between cooperating partners, to create synergistic effects by carrying out this project.

(ID 016) Deep Atmobiogeochemical Anomalies and Haloes of Mercury

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Our researches of Hg biogeochemistry, which were begun in 1966, have established that it

forms highly contrast mercury anomalies in plants at low or inconsiderably increased contents in soils and soil-forming rocks. Their comparison with soil-geochemical and blasthole gaso-mercury data allowed to come to the conclusion that the main source of mercury for plants is its gaseous (mainly vaporous) forms in underground air of the rootinhabited zone. So, it was established that the observed biogeochemical anomalies are often atmobiogeochemical ones stipulated by rather intensive absorption of mercury gaseous forms by roots according to the non-barrier type. Plant-gaseous coefficient (PGC) of mercury, which is equal to ratio of its contents in plants nonbarrier bioobjects and in underground (PGC_u) or overground (PGC_o) atmosphere also as for other chemical elements is equal to in average 15.000 at a rate of the dry substance and 300.000 at a rate of ash of plants samples with correction of its significant 90-95% loss while burning samples.

The important result of our researches is establishment of possibility to determine Hg in plants and animals ash burnt at the temperature 400-800°C. Developed original methodics of Hg determination in plants ash was approved in Buryatia and Canada. It made possible the study of Hg biogeochemistry using plants ash having been prepared for analysis for revealing the majority of chemical elements. Special researches showed that low-temperature analytical forms of Hg going out the ash at 700-800°C are stable during more than 10 years in comparison with fresh, dried and crushed out plants samples, from which mercury volatilizes in considerable quantities (up to 80-95% and more) during several years.

In Buryatia more than 160.000 samples of plants ash were analyzed for Hg and the following features of its absorption by plants were established: 1) Biogeochemical anomalies and Hg haloes in plants non-barrier bioobjects accompany all studied species and geochemical types of ore deposits and Hg, Sb, As shows of ore, polymetals, rare metals, precious metals, rare-earth elements – TR, Sr, Ba, Fe. 2) When there is no ore mineralization these Hg anomalies are usually connected with the zones of jointing, crushing and tectonics dislocations. 3) Increase of thickness of covering loose formations including sands of aeolian origin doesn't essentially influence on intensity of biogeochemical anomalies in connection with a significant ascending migration of Hg vaporous, which causes large deepness of mercury-biogeochemical information. According to the data of gaso-mercury survey the deepness of mercury-biogeochemical data can reach hundreds meters and even 1-2 km. 4) Owing to

ascending migration of Hg vapors, formation of sorptional mercury anomalies in humic soils horizons is possible, which is often in our opinion, wrong, is explained by its fallout with atmosphere sediments. High contents of Hg in soils humic horizons in comparison with underhumic ones having an evident deep origin was observed in almost all our researches. 5) Due to ascending Hg migration from interior part of the earth including upper parts of its mantle the pollution of plants, underground waters, springs, boreholes, open basins is possible. That is such origin that pollutes, in our opinion, significantly Baikal waters and drinking wells in the sector Severobaikals-Nizhneangarsk, which exceeds Limit of permissible concentrations (LPC) in to 100-130 times (Kovalevskii, 1997). It is characteristic for similar seismic regions, where during the earthquakes short impulses of ascending vaporous can be observed. 6) Owing to distant rising migration of Hg gaseous forms the biogeochemical method using plants nonbarrier bioobjects can be used while prospecting deep occurrences deposits of the different minerals including oil and gas.

Biogeochemistry problems, which are analogue the ones having considered for Hg, also take place for S, Se, F, Cl, Br, I, Rn and other gaseous migrants.

Session 2. Environmental Geotechnology **Sekcija 2. Okoljska geotehnologija**

(ID 001) Ground Subsidence Due to Oil Production, the Case of the Costa Oriental of Lake Maracaibo, Venezuela

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Ground subsidence associated with oil production in the east coast (Costa Oriental) of Lake Maracaibo (COLM) in western Venezuela) was detected as early as 1929 and has reached as much as 6.4 m in areas of intensive oil production as of April 2004.

The topography of the area (low, swampy lands) prompted the need to protect inhabitants and oil industry installations from lake waters with earthen coastal dikes.

The progressive construction of these dikes was started in 1929 and is still in progress. These dikes, together with inner diversion dikes as well as a sophisticated drainage and pumping system, conform the Costa Oriental Protection System with the "polders" of Tia Juana, Lagunillas and Bachaquero, which correspond to the oilfields of the same names, collectively known as the Costa Oriental oilfields.

The coastal dikes are located in a seismic area of low to moderate intensity. Seismic geology and seismicity studies were carried out from 1985 to 1988. These studies showed a moderate seismic risk, mainly due to the possibility of liquefaction of a loose, saturated, silty sand layer in the dike foundation soils.

Mitigative measures, consisting of downstream berms, soil improvement by means of compaction piles in some sections, and the extension of the upstream riprap protection system have been implemented in about 25 of the total 47 km of coastal dikes.

The implementation of these mitigative measures has increased the return period of the design earthquake from about 130 years to 3,000 years, the return period typically used worldwide for the design of earth dams in seismic areas.

This project is a good example of what should be the appropriate interaction of natural disaster prevention with sound development plans prepared by the Venezuelan oil industry.

(ID 015) Ground Subsidence Measuring, Monitoring and Modeling in the Costa Oriental Oilfields in Western Venezuela: The Last Fifty Years

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Oil production from shallow (300 to 1000m), unconsolidated reservoirs in the Costa Oriental (Eastern Coast) of Lake Maracaibo in western Venezuela has caused significant ground subsidence over an area of more than 2,000 km². Subsidence has been monitored since the late 1920's and has reached, as much as 6.4 m in areas of intensive oil production as of April 2006 with rates as high as 0.26 m in areas of intensive oil production.

The topography of the area (low laying,

swampy ground barely above Lake level) has resulted in the need of progressively building earthen coastal protection dikes which, together with inner (diversion) dykes and an elaborated drainage system.

A leveling network was established in Lagunillas in 1929 and later extended to other oil fields. To date network covers an area of about 1,600 km² and comprises 1,889 bench marks in land as well as 329, in the lake in near shore oil well platforms. The subsidence monitoring surveys are conducted at two-year intervals. In 1988 GPS (Global Positioning System) techniques were incorporated in the leveling campaign with encouraging results. There are more than 60 years of subsidence history, a significant treasure from a scientific point of view.

Three subsidence prediction programs (HUNDCALC, SINK and SUB 3D) have been developed in recent years however, due to their inherent complexity, the SINK and SUB 3D models are only used for specific areas whereas the HUNDCALC model is used for more general prediction requirements.

At the time of the writing of this paper consideration is being given for the possible use of InSAR and other novel technologies for ground subsidence measurements.

This paper will describe in detail the subsidence measuring and prediction and give an account of the experiences of the author who, for more than 50 years, has been involved with subsidence measuring, monitoring and prediction activities.

(ID 076) Problems of Geoenvironment Stability Upon the Subsurface Development in Moscow

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Subsurface development in Moscow includes cutting metro and highway tunnels, construction of high-rise buildings with deep foundations, and the reconstruction of old buildings using upper horizons of the subsurface.

Geological properties of the subsurface are not adequately taken into consideration on planning underground engineering structures in densely built urban area. The functional purpose of the object and its anchoring to urban infrastructure appear to be the main criteria for choosing sites of subsurface construction. Mesozoic and Cenozoic clay and water-saturated sand occurring in the upper part of geological section as well as the underlying karstified and fractured Carboniferous limestone with confined aquifer is the enclosing environment for the subsurface engineering structures.

The cases are known of loosing geoenvironment stability upon underground construction, e.g., the quicksand breakout into shafts and tunnels, suffosion outwash of watersaturated sand in deep pit walls, karst and suffosion intensification upon decreasing the groundwater pressure due to pumping out water at construction sites, rock shifting in the mining roofs, etc. The disturbance of existing technonatural conditions upon the subsurface development may cause deformations of buildings and engineering structures. To preserve the geological environment stability in the megacity, the territory zoning is performed by the subsurface development conditions in respect to various natural and technogenic factors. The geological environment of Moscow is typified on the basis of the analysis of modern and ancient topography, geological structure, geodynamic conditions, and hazardous exogenous processes. Requirements to assessing difficulty of subsurface development are worked out.

(ID 092) A Deformation Monitoring with Simultaneous Heterogeneous Observation System

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Adequate measuring networks for objects' deformation monitoring have to meet high demands regarding selected known (starting) points and deformation network design. Selected known points have to assure stable frame of deformation network and their position must be determined with adequate accuracy.

Deformation network design also have to assure correct geometric transfer of coordinate differences regarding variance-covariance propagation law. The stated requests are assured even harder in mining and geotechnology because monitored objects are usually above underground excavations or underground building sites. The objects monitoring in this article is presented with quantities that are independent (invariant) from datum of known points. This quantities are slope distances between objects' characteristic points. In presented example observations between objects' characteristic points were not possible.

From the initial epoch results it is concluded that on the base of precision estimations of slope distances between object's characteristic points is expected that it will be possible to monitor slope distance changes larger than 10mm in any direction in space (at $\tau = 2$, the probability is 95,45%). If the most favorable conditions are considered, it will be possible to monitor slope distance changes larger than 3mm (at $\tau = 2$, the probability is 95,45%).

(ID 077) Technogenous and Natural-Technogenous Ground Collapses in Moscow

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Since 1969 till 2006, about 150 cases of ground collapses and surface subsidence were registered in the territory of Moscow megacity. Some of them resulted into ruining of buildings and disturbing subsurface service lines. Collapses and surface subsidence is the manifestation of karst-suffosion and suffosion processes; they may be also caused by the quicksand breakout to underground mine workings and construction pits. These processes arise as a result of the disturbance of engineering protection in deep construction pits; breaking of water-supply pipelines; underestimation of geological conditions upon engineering survey at the sites of ancient buried river valleys; as well as the alteration of geodynamic conditions in the urban territory.

The human-induced intensification of karst and suffosion processes took place in the north-west of Moscow in 1960-1970s. In 1969, a 5-storey dwelling house was ruined in the Khoroshevskoe Highway due to the surface collapse. The reason was the alteration of geodynamic conditions upon decreasing pressure in the Carboniferous aquifer and the simultaneous rise in the groundwater table, which led to the suffosional wash-out of Quaternary sand to karst cavities and fractures in the underlying Carboniferous limestone.

The accident that happened in May 1998 in the centre of Moscow (B. Dmitrovka Street) is the case of disastrous development of technonatural processes in the area occupied by the ancient buried river valley. Upon laying subsurface manifold system, the unknown earlier erosional valley filled with water-saturated sand was met. Breakout of water-saturated sand into tunnel face produced a surface sinkhole and ruined the building. Several sinkholes are registered in the vicinity of deep construction pits accompanied by the intense ingress of water into the pit.

The detailed engineering geological survey at the problematic sites will permit revealing the

reasons of the process intensification as well as improving the protection measures, the monitoring system, and the requirements to engineering survey.

(ID 054) Preliminary Study on Influence of Deep Mining on the Movement of Strata and Ground

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With the increasing of coal mining depth, the surface subsidence caused by deep mining differs from that caused by shallow lay, for the complex change of the mechanics behaviour of rock mass in deep mining. The results based on numerical simulation and actual measurements indicates that at the given mining width, the changing extent of surface movement and deformation in deep mining are less than in shallow mining. The surface subsidence in deep mining is influenced by the increasing of key strata that control the movement of overburden rock mass. The coal pillar far from working face will deform differently under great ground stress, and the holistic compression or deformation of coal and rock pillar is the special constituent of surface subsidence in deep mining, which lead to the influence sphere and movement boundary line in deep mining are larger than in shallow mining. These bring great influence to the value of dynamic angle of draw in deep mining.

(ID 059) Environmental Degradation and Associated Ecological and

Health Issues in a Tropical Wetland Area

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Human impact on the environment leads to serious health issues and ecological problems in many parts of the World. In the Kuttanad wetland area in Kerala, India, failure in a development project now deteriorates the water quality, making life inhospitable to living organisms. Kuttanad is a typical coastal wetland with most of the area lying nearly one metre below sea level. Through generations, rice cultivation has been made possible by constructing dikes and pumping out water. Measures to multiply crop production and projects to prevent brackish water intrusion and evacuation of floodwater deteriorated the surface water and groundwater in the entire wetlands area. Five major rivers join this wetlands and their floodwater carrying domestic, industrial and agricultural pollutants flows to the backwater and Sea through this wetland only. Control of natural water flow through regulators disturbed the natural flushing, causing concentration of pesticides, fertilisers and industrial and domestic wastes on logged water and also promoted uncontrolled growth of weeds. The projects to prevent brackish water intrusion produced negative results and the targeted rice production could not be achieved. Rate of deterioration is so large that the quality of freshwater resources in many locations is far below safety level. The ponds, wells and canals on which majority of population depended for all domestic purposes are now highly contaminated. Many native species of fish, reptiles and amphibian faced extinction and the challenge still continues. Health issues are becoming serious. Water borne and vector borne diseases are spreading, and mosquitoes are multiplying fast. The wetland with rich biodiversity, capable of providing livelihood for millions in the area is also under threat also from the indiscriminate utilization, encroachments, reclamation, sand quarrying and urbanization. Even with three times the global average rainfall and fertile land, the region experiences serious seasonal water shortage and food crisis because of the lack of proper conservation and management. The proposed schemes river diversion, inland navigation and tourism promotion will accelerate the degradation of the ecosystem. Change in river runoff due to climate change, globalisation and associated rapid industrialisation and urbanization

and the growing population make another challenge. In this study, a detailed analysis of the environmental degradation in the wetlands and the resulting ecological and health issues have been made. The State needs adequate environment and health policies and a strong political will to implement it. Some suggestions for policy guidelines have been presented.

(ID 102) Environmental Pollution

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Now a days environmental pollution is one of the most talked of topics of the world. Our environment is polluted in two ways-air pollution and water pollution. Air is polluted in many ways, smoke polluted air, man makes fire to cook his food, to make bricks, melts pitch for road construction and burns wood, all these things produce heavy smoke and this smoke pollutes air. Railway engines, mills and factories and power house use coal and oil, buses, trucks and cars use petrol and diesel. Again all these things cause air pollution.

Water is polluted in many ways. Farmers use chemical fertilizers and insecticide in their lands to grow more food. The rain and floods wash away some of the chemicals. They get mixed with canal water and river water. Mills and factories pollute water by throwing the waste materials and unsold products in to the rivers and canals. Steamers, launches and even sail boats pollute water by throwing oil, food waste and human waste in to the big canals and rivers. Unsanitary latrines in the country side standing on the banks of the rivers and canals also pollute water.

Sound pollution is one of the talked topics of the day. It has reached an unbearable level. The unnecessary use of powerful vehicular horns is the main source of sound pollution in the city. Besides, faulty vehicles, construction sites, loudspeaker and thousand of workshops let out loud-noise round the clock. In the city millions of people especially children are exposed more to sound pollution.

Arsenic pollution one of the big problems of our country. Arsenic pollution is causing much harm to human life. It is found in water especially in tube-well water. By drinking this water people

are suffering a lot. It causes sore in the fingers or in any other part of the body.

Over six million people live in Dhaka city and each day they procure 3,000 tons of household waste, yet in Dhaka city corporation collects less than half of it. The rest remains of roadsides in open drains in law-laying areas. This has a negative impact on the city's environment. It is estimated that the population of Dhaka will be 19.5 million by 2015. It will become very difficult to find sites to bury the waste as the city expands and transport costs to transfer the waste will increase.

Waste is what we throw away everyday. It includes everything from unwanted old cars to cigarette packets. As the amount of waste is growing rapidly all over the world and polluting the environment, the time has come to think about it very seriously. We cannot all together get rid of our waste, but a proper management of it can certainly reduce it. If we think of burning, burying recycling and thus reducing our waste, we can save our environment to a large extent. We can use some waste as fuel. We can use vegetable waste to make compost to improve our soil.

More and more companies should come forward to promote greater recycling and changes in consumption patterns to reduce the amount the waste and help people to save the environment. A proverb goes that a stitch in time saves nine. So we should do the right thing at the right moment because timely action brings for us great success and saves us from a lot wastes. Moreover, we know prevention is better than cure. So it is right time to take proper steps and necessary measure to raise awareness about the problem of waste management.

(ID 004) Oil Discharged, Spilled Pollution in Sea Water Engineering Design of Treatment of Process Waste Water

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The fate of petroleum spill in a marine estuarine sea environment as related to biodegradation processes will in compass degradation via microbial metabolism ingestion zoo plankton uptake and possible retention by marine invertebrates and vertebrate. In other to study the impact of oil pollution in sea the specific group of organisms such as hydrocarbon degrading and sulphate reducing microbes can be monitored since oil is composed of hydrocarbon and sulphate. The study identified certain engineering designed of treatment of process waste water on oil discharged spilled over and pollution in sea water.

Session 3. Environmental Geotechnology
Sekcija 3. Okoljska geotehnologija

(ID 075) Landslides in Belo Horizonte, Brazil

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In Belo Horizonte, landslides are associated with the rainy season that occurs from October to February. In the past recent years, annually, an average of 40 people died due to slope failures that occur in the risk-areas at the city surroundings.

This paper presents the results of two successive rainy-season monitoring carried out in the "Taquaril" slope, located at the "Taquaril" neighborhood. Also, it includes the following slope's studies: stability analysis, geological and geo-morphological characterization. Here, the main goal was to explain why this slope has failed and to identify the main trigger mechanisms.

“Taquaril” slope occupies an area of about 145,2 ha and about 30.000 people live in this risk-prone area located at “Belo Horizonte Complex” geological formation. This terrain is characterized by steeply slopes composed by weathered phyllites and schists, and by unconsolidated colluviums and talus deposits. Shallow rotational slides were observed in “Taquaril Slope”, specially, when four-days accumulated precipitation rate reaches or exceeds the threshold rate of 100 mm. Deeper failures that reaches the rock mass occurs when the rock discontinuities are filled with water and the weathering degree of rock mass is high. Anthropogenic actions such as the man-made horizontal and vertical cuts to set up houses in this unstable geological area, associated with high precipitation rates were considered to be the main causes responsible for the landslides triggering.

(ID 066) Control of Methane Accesses from Coal Seams at Day Ground

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For the structural control of gas accesses in built-over and to-be-built-over areas the expected gas volume current is to be estimated during the planning and dimensioning of gas drainage systems. In order to make a substantiated statement with regard to the quantity of this gas volume, the source term will be introduced as a forecast model which can be consulted for the calculation of the currently expected gas volume. The source term is a basis for the planning in order to secure buildings, adjacent areas, traffic areas and line marked-out routes against methane spreading and methane accesses. It can be determined on the basis of the geology and the knowledge about mining activities.

In order to minimise the exposure resulting from gas emissions, safeguarding measures have to be initiated in areas with existing and possible gas emissions; normally areas with subsurface coal mining.

The status quo of the technological development requires drainage systems of

mineral building materials in case of:

- safeguarding measures against methane accesses in the area of buildings and adjacent areas,
- prevention of gas spreading in the area of highways and line routes.

At this point geotextiles respectively geomembranes as an alternative both to the present procedure for the structural control of methane accesses at the surface and the demands to these alternative building materials will be described.

(ID 029) The Mechanism of Coal and Gas Outburst Explained by Dynamics of Systems with Variable Boundaries

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The change of the boundaries of coal seal covering gas (CSCG) are described before the analysis on the basic motions in CSCG. The coupling between the deformation of coal and the migration of gas, and the coupling among the desorption, diffusion, and seepage of gas are discussed respectively. Several assumption about the mechanic properties of CSCG, involving the properties about the desorption, diffusion and permeability, as well as the stress-strain relation of coal post yield, are put forward. The basic variables, constitutive variables and control parameters are analyzed, and the dynamic equations of CSCG in both elastic and plastic zone are constructed respectively. Coal and gas outburst (CGO) is explained from the viewpoint of dynamics of systems with variable boundaries (DSVB). It holds that CGO is a procedure in

relation to variable boundaries, which are caused by the failure of material. Whether does CGO take place is decided by the gas migration during the change of boundaries of coal seam; if the fractures are interconnected, and gas is unstuffed, accumulation of gas energy can't exist in the fractured zone of coal-seam, CGO will not happen; on the contrary, if the fractures are closed under the action of crustal stress, and crustose fractured zone may form a kind of structure which can carry load because of the self-sealing of gas pressure; when gas energy accumulated in the fractured zone to a certain extend, the crustose structure will clap, and outburst takes place.

(ID 031) Drainage Methods of Coal Bed Methane and Its Application in Jincheng Mine Field in China

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Gas is one of the biggest threatens to safety production in coal mine and the destructor of humans' living environment, so the efficiency drainage before mining and using of CBM has been paid more attentions. In allusion to the complicated geologic particularities of CBM occurrence in China such as: low reservoir pressure, poor permeability and low saturation and so on, the current drainage methods of CBM and its relative merits are discussed in this paper, which include: gas drawing underground, surface vertical well suction, simultaneous extraction of gas and coal, and gas drainage from abandoned coal mine etc. Besides, the applicability of these methods is probed by integrating the specific condition of Jincheng coal mine area in China. The investigation results provide reference for efficiency drainage and utilization of CBM in China.

Moscow Territory - Retrospective Analysis

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Moscow is one of the largest European cities, where there are many industrial plants, research-and-development centers and medical institutions, using in its work sources of ionizing radiation. Despite of strict radiation safety law observance, activity of these organizations brought to radioactive contamination areas on Moscow territory. Mainly it is connected with lack of radiation hazard understanding at the beginning of «nuclear era». In 40-50th years of last century, when contaminated equipment or used sources of ionizing radiation often were not buried in special spaces, but were dropped in holes beside the city boundaries. Now these territories are included in city boundaries and built up. Since 80th till middle 90th years of the last century on Moscow territory, due to MosNPO «RADON», NPO «Aerogeophysika», Central geological prospecting expedition and other organizations, ground gamma-survey 1:40 000 scale was done. As the result a lot (more than 1000) of radioactive contamination areas, connected with human economical activity, were revealed. Mainly these are contaminated grounds and soils, different equipment, medications, old aircraft devices and household goods (clocks, New-Year tree decorations and etc.) with constant active phosphor (CAP), containing ²²⁶Ra. Contaminated areas square, as usual, did not exceed 1 sq.m, but large unapproved dumps with some hectares square were also revealed. Gamma-radiation dose on the surface of the contaminated areas, varied in wide range from 100 mkR/h till 3-5 R/h. Pollution radionuclid composition consist of ¹³⁷Cs and ²²⁶Ra, rare ²³²Th, ⁹⁵Zn+⁹⁵Nb and ⁶⁰Co. In single instances, contaminated areas have traces of transuranium elements – plutonium and americium. Besides listed local radioactive contaminated areas, in Moscow soils often ¹³⁷Cs can be found, presence of which is determined by atmospheric precipitates due to the Chernobyl atomic power-station failure, and nuclear tests in atmosphere.

Since middle 90th years of the last century

(ID 069) Radioactive Contamination of

due to Moscow government regulation obligatory radioactive survey during any building-up works were organized. State medical epidemic institution and Labs of radioactive control in building organizations measure gamma-radiation dose within developed areas and radionuclid specific activity in grounds and soils. These measures are effective. Number of new revealed radioactive contaminated areas decrease every year. Now not more than 10 new areas are revealed ever year in the city. Intensive works are underway on decontamination of early revealed areas.

(ID 047) Mine Transient Electromagnetic Method and its Application in China

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Mine transient electromagnetic method (MTEM) applied to the prediction of the water-bearing structure in the mine has been developed recently, the small multi-turn loop is adopted and it has many advantages compared with other technology, which are low in cost, and high in accuracy and efficient. The data received is easily interrupted by the metallic body when the transmitter with magnetic bipolar source is used, so the transmitter with electric dipolar source is put forward. Finally, problems needing to be solved in further researches are pointed out.

(ID 048) Mine Environmental GIS: Framework, Key Techniques and Case Study

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The large-scale coal mining has caused serious environmental pollution and ecological damage in the coal mining areas in China. The serious conditions are listed as below: the geological disasters such as landslide, dilapidation, mud-rock flow and so on aroused by mining subsidence; the side effects such as land occupying, side sloping, filtrating and raised dust brought by the waste rock and gangue heap; the ruin of the water cycle system when the groundwater is drained and the waste water is discharged; the air and noise pollution during the coal mining and the transporting processes. Based on the characteristics of acquisition and management of environmental information in China as well as the theory and technology of environmental informatics and GIS, the Mine Environmental GIS (MEGIS) was studied and developed, and some key techniques were investigated. The objective of MEGIS is to manage, inquire and analyze environmental data and provide users with decision support for environmental protection. In the MEGIS, both the Point Mode and the Region Mode of the Gaussian Air Diffusion Model are used to simulate air pollution, and the water quality model is used to simulate the water pollution in 1-dimensional and 2-dimensional. The spatial discrete concentration points are used to build up Triangulated Irregular Network (TIN) which creates a new *isoline* or *isosurface* for environmental analysis in mining areas. Mining subsidence simulation and prediction model was used to analyze ground surface subsidence caused by mining. Using the proposed MEGIS it is much easier to update, manage and analyze environmental data, further to support environmental management decision-making.

Session 4. Environmental Geotechnology **Sekcija 4. Okoljska geotehnologija**

(ID 078) Measurements Simulation for

Optimisation of Trigonometric Network Monitoring

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Environmental impact monitoring often also consists of measuring the displacements in trigonometric network on inflicted areas (changes on landfills, above subsiding mining areas, ...). Here presented measurements simulation is based on the model of 2D adjustments by parameter variation², made with the NTF method, which enables traceability of changes caused by changing the input data. The aim is to control data with MS Excel through entire process of adjustment of those displacements in the most transparent and automated way. Through introducing a switcher we gain the opportunity to improve the final results by excluding bad single or groups of measurements from the input data set. It also gives us the option to define the measurement points as either known or unknown. Once the specific data has been switched off/on, this affects all the other subordinate data in the adjustment. In combination with other calculative tools, ie. the mean square error, we can evaluate the influence of the specific data on the adjustment results and reliability of the trigonometric network, be it either real or simulated.

(ID 079) Influence of a Non-Nodal Point in the Adjustment of Local Levelling Networks

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A local levelling network is composed of bench marks (points), which can be connected into topology loops. These points can be nodal or non-nodal points and have different influence in the adjustment of a local levelling network. Non-nodal points can be excluded from the adjustment by which we achieve better overview of relevant information about a levelling network. By excluding non-nodal points from the adjustment the number of normal equations is reduced. Non-nodal points can be included in the adjustment if we want to get information about non-nodal points. Calculated values, accuracy and functions of nodal points are identical to those we get by including nodal points in the adjustment of a local levelling network. When estimating the quality for field monitoring, which is under the influence of mining, it is better to include only nodal (relevant) points.

(ID 017) The Radioactive Elements of Plants

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There are all natural radioactive elements and artificial radioactive isotopes in plants. The author studied the root entering of U, Ra, Th, K in plants and aerosol pollution of them by radioactive isotopes. Their main result was the revealing of non-barrier and direct proportional to the concentration in the environment accumulation of radium by all 139 investigated species of plants and their parts, and mainly barrier, to some limit for each bioobject, – the accumulation of U, Th, and K by the overground bioobjects. The table of grouping by 80 bioobjects of Siberia according to their quantitative barrier characteristics and informativity for U in the rootinhabited zone was published.

According to the investigations the scientific fundamentals have been worked out and the examples of highlyeffective biogeochemical prospecting of uranic ores for radii in plants determined with the help of alpha-analyse of plants ashes have been received. According to the received information due to root systems, the depth of which is usually 2-10 m and in the zone od arid climate it reaches 30-70 m. Plants can be bioindicators of deeply occurred uranic and

thorium ores or burying of radioactive elements. Finding radioactive elements in underground waters in the soluted state the depth can reach 100-200 and even 1.000 m at the expense to rising migration with pressure artesian waters or under the influence of electric current according to the hydrobiogeochemical model. The accumulation of radon by plants can happen according to the atmobiogeochemical and hydrobiogeochemical models. The conclusion was made that the main physiological influence of U on plants is connected with its chemical but not radioactive properties and as for radioactivity alpha-radiation of Ra and the products of its decomposition has the greatest significance.

For aerosole pollution of Siberian plants by the products of nuclear explosions the regularities connected with the mechanisms of aerosole sediment have been established. According to them the greatest radioactivity has been observed in moss and lichen. As for wood plants the surface of rougher bark of larch (*Larix dahurica* Turcz.) had the greatest pollution. The wood (timber) and roots of all trees were practically clean from pollution. Large "hot" particles of radioactive falls resembling dross are of the greatest danger for man and animals. Their size according to our information reached 3x2x0.5 mm, and radioactivity considerably exceeded 100% of the equivalent equilibrium uranium. It was quickly decreasing during some days and weeks and in 3-6 months it was almost imperceptible. At radiographs of plant ashes 3 types of pollution have been recorded: 1) the even blackening of X-ray film at the Ra concentrations reaching 0.1-0.3% equivalent U exceeding the local background (0,000n%) to 200-2000 times; 2) the small points of blackening with the size to 1 mm connected to aerosols with the size to 0.1 mm; 3) the rare large spots with the size to 1 sm connected with particles with the size 0.3-3 mm.

Risk assessment of urban water systems can be divided into three different parts:

1. Identifying failures
2. Determining probability of failure
3. Estimating the consequences of the failures

By definition failures occur when stress exceeds resistance, then values are permanently lost or things are damaged to such an extent that measures have to be taken in order to restore the damage. The receiving part of the system has a certain capability of resisting the stress that the pressuring part of the system imposes on the receiving part. An example: a lake can absorb a certain load of phosphorus before it is influenced to such a degree that conditions in the lake change significantly – eutrophication occurs. When uncertainty is included in the analysis the probability of failure is equal to the probability of the stress exceeding the resistance. The risk can then be calculated as the probability of a failure multiplied by the expected cost associated with failure. This way of calculating the risk corresponds well to the definition that risk is equal to probability times consequence.

Construction and improvement of urban runoff systems is very expensive. It is therefore interesting to find a runoff system that reduces environmental risks as well as possible, and at the same time keeps the expenses for construction and maintenance at a minimum.

With the above described way of assessing risk, by estimating the expected cost of failure, risk can be included in a traditional Cost-benefit framework. A Cost-Benefit-Risk analysis can then serve as decision support for decision-makers in urban water systems.

This paper discusses the first two parts of risk assessment: different failures that can be identified in the urban water system and methods to calculate probability of failure.

(ID 063) Risk Assessment and Decision Support in Urban Water System

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In the urban runoff system different things can go wrong, -different failures can occur such as oxygen depletion or hydraulic damage in the receiving river, flooding of the urban catchment etc.

(ID 006) Environmental Impact Assessment, Automotive Fuel Emission, Pollution and Health Effect Control

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Study has examined automotive emissions and the possible outcome of effects to improve air quality by altering the mix of motor vehicle fuels the major air pollutants are lead carbon monoxide volatile organic compound VOC nitrogen oxides NOS sulphur oxides and particulates. These materials are produced by following sources transportation fuel combustion industrial processing solid waste disposals. Lead is the most harmful pollutant and probably the easiest to be eliminated over time. The other pollutants have been reduced but they are more difficult to control because emissions of them tend to increase with growth in population economic and industrial activity. Efforts are made to study the environmental of automotive fuel emission pollution health effect and control measures.

(ID 005) Disaster/Hazards of Environmental Pollution in Petroleum Refining Industries, PetroChemical Complexes in the Niger Delta Atlantic Coast of Nigeria

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Along with economic benefits industrialization has also brought with it disasters hazards of environmental pollution. The resulting effect on air water soil and biotic indicate the need for monitoring environmental pollutant and measures for its control. This research deals with the disaster hazards of environmental pollution due to the petroleum refining technology industries and petrochemical complexes in the Niger Delta Atlantic Coast of Nigeria. Obviously this area is facing critical pollution problems as

very few studies and survey are conducted in environmental engineering research and environmental development. Increasingly toxication hazards, disaster and non availability of data prompted the present study.

(ID 057) Market Analyse and Demand Estimate of Construction and Demolition Waste: The Case Study of the Municipality of Rio De Janeiro

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The purpose of this work is to analyze the economic aspects of civil construction aggregates, such as market and competition study, as well as to estimate the supply and demand of these materials in the municipality of Rio de Janeiro.

Emphasis is given to recycled aggregates because the results obtained from the proposed analysis will later allow a feasibility study for the implementation of recycling plants of solid residues from construction and demolition (C&D) waste in the municipality of Rio de Janeiro.

The use of recycled aggregates has been an alternative seldom used for solving housing and infrastructure problems. As a major aggregate consumer on account of the construction of popular houses and infrastructure works, the public administration could adopt policies to promote recycled aggregate consumption.

In relation to the C&D waste reception, the recycling centres have as competitor the municipal landfills. According to the Brazilian

state-of-art, the land fills need large amounts of inert material to cover the landfill cells. The inert landfills are also competitors of recycling centres in relation to reception of C&D waste. There are in the Municipality of Rio de Janeiro plain areas to where the city is expanding, that may be elevated.

**(ID 053) The Life Cycle Thinking Model
for Approximating
Neighbourhood Environmental
Practice Relating to Solid
Municipal Waste Management**

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The waste subject is a huge area at the economy of the every State, and it is extreme important to find the right priorities between its possible management options.

Recently the consideration of the New Directions for Environmental Management in Russia, including the waste problem, was initiated by the World Bank in view of the current administrative reform of Russian Government and the new stage in the Bank activity. During the consideration, the discussions on the Utilization Problem have been started. It was noted some doubt regarding the further progress and the right efforts at the Reuse-Recycling-Recovery option (i.e. "utilization"). Towards the problem solution there are known investigations at looking for optimal level of solid municipal waste utilization. Also, it has noted the problem on optimal waste abatement in industry.

The Problem is especially urgent for Northwest Russia as the contiguous region being two-way window to the EU. For its illustration we have pointed out the Solid Municipal Waste problem, where we have now less of 5% by utilization.

At last, the research into waste elimination needs to be equally broad bred in its scope to overcome this global international challenge. So, we are looking for Knowledge Management developments at the waste handling sector, and the Life Cycle Assessment looks as the prospective tool for this.

**B. WASTE MANAGEMENT/
GOSPODARJENJE Z ODPADKI -
GzO'07**

**Session 5. Waste Management/
Sekcija 5. Gospodarjenje z odpadki**

(ID 093) Izvajanje uredbe o odlaganju odpadkov v praksi

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Predpis, ki povzema določila Direktive Sveta 1999/31/ES z dne 26. april 1999 o odlaganju odpadkov na odlagališčih, določa mejne vrednosti emisij snovi v okolje zaradi odlaganja odpadkov, obvezna ravnanja in druge pogoje za odlaganje ter pogoje in ukrepe v zvezi z načrtovanjem, gradnjo, obratovanjem in zapiranjem odlagališč. Določa tudi pravila ravnanja v zvezi z zapiranjem odlagališč ter ravnanje po njihovem zaprtju. Govorimo torej o Uredbi o odlaganju odpadkov na odlagališčih predpis, ki je bil objavljen leta 2006, pred tem pa je to področje urejal pravilnik iz leta 2004.

Inšpektorat RS za okolje in prostor je kot pristojni nadzorni organ v letu 2006 in 2007 nadziral izvajanje predpisa pri upravljavcih obstoječih odlagališč odpadkov. Ugotovitve inšpekcijskega nadzora kažejo na visoko korelacijo med razvitostjo ločenega sistem zbiranja odpadkov v gospodinjstvih ter tehničnega standarda posamezne lokalne skupnosti glede zajemanja ločeno zbranih frakcij komunalnih odpadkov v povezavi s količino odloženih odpadkov. Ena ključnih ugotovitev je tudi nezadostno poznavanje zakonodaje in koncepta ravnanja z odpadki pri izvajalcih javne službe pa tudi na nivoju lokalnih skupnosti. Za doseganje ciljnih količin biorazgradljivih odpadkov, količin zbrane odpadne električne in elektronske opreme ter odpadne embalaže, bo potrebno uporabiti še dodatne instrumente okoljske politike, ki bodo uporabnike motivirali k izvajanju predpisanih ravnanj.

(ID 081) Okoljska dajatev zaradi odlaganja odpadkov – instrument financiranja v Sloveniji v obdobju 2001- 2006

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Eden izmed osnovnih ciljev Nacionalnega programa varstva okolja v RS je zagotavljanje boljšega življenjskega okolja. Kot eno slabše rešenih nalog v okviru varstva okolja, je bilo v fazi sprejetja tega programa, med prednostna področja uvrščeno tudi področje odpadkov. Pregled stanja na odlagališčih na prehodu v novo tisočletje je potrdilo domnevo, da večina odlagališč, predvsem komunalnih odpadkov, ni zgrajena v skladu z evropskimi standardi. Kot posledica takega neustreznega ravnanja pri postopkih odlaganja odpadkov, je bil zaznan negativni vpliv na naravno okolje, kot npr. prekomerno sproščanje metana v ozračje, potencialno ogrožanje podzemnih voda in tudi površinskih voda ter onesnaženje tal. V letu 2000 sprejeti prvi predpis o odlaganju odpadkov je določal tehnične standarde in obveznosti upravljavcev za primerno odlaganje odpadkov. Kot je bilo pričakovati, so se ti pri izvajanju tehničnih in administrativnih zahtev zakonodaje, srečevali s finančnimi težavami, predvsem pri izvedbi zahtevnejših ukrepov. Zato naj bi imela v letu 2001 uvedena taksa, oz. od leta 2004 dalje okoljska dajatev, stimulativni učinek za doseganje ciljev za izpolnjevanje predpisanih zahtev zakonodaje. V prispevku je navedena zakonodajna podlaga za uvedbo takse oz. dajatve kot mehanizma za financiranje okoljskih naložb, opredeljeni so infrastrukturni objekti, ki so bili od sprejetja pa do konca leta 2006 lahko predmet investiranja s sredstvi takse oz. dajatve, prikazani so podatki o vloženi sredstvih na nivoju države za obravnavano obdobje.

(ID 081) Environmental Fee Due to Waste Deposit – Financing Instrument in Slovenia in the Period 2001- 2006

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One of basic goals of the National Programme of Environment Protection in the Republic of Slovenia is to assure better living environment. As one of worse tasks solved within environment protection during the phase of the programme acceptance, there was ranked among priority areas also the area of waste. Checking the state of waste deposits during transition into the new millennium, assumptions that majority of waste deposits, mainly municipal landfill sites, were not built according to European standards, was confirmed. As a consequence of such improper treatment at waste deposits processes, a negative impact on natural environment has been noticed, such as excessive methane discharge into the air, potential endangering of subterranean water as well as surface water and pollution of the ground. The first regulation about waste deposit, adopted in the year 2000, determined technical standards and operator's obligations with regard to proper waste deposit. As anticipated while implementing technical and administrative requirements of legislation, these were faced with financial difficulties, mainly at implementing more demanding measures. It is for that reason that the tax, introduced in 2001, namely since 2004 environmental fee, was supposed to have stimulating effect on achieving goals for fulfilment of legislation requirements stipulations. The paper states legal basis for tax introduction, namely fees as a mechanism for financing environmental investments, determined are infrastructure objects, which could be since adoption till the end of the year 2006 subject to investment through taxes, namely fees, there are data about capital investment on governmental level presented for the discusses period.

(ID 025) Wastes in Finland and Waste Management Strategies in Helsinki Metropolitan Area

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Approximately 127 million tonnes of waste and comparable by-products were generated in Finland in 2000. Of this total amount, the largest quantities are surplus soil from construction (34 million tonnes), wall rock, ore dressing sand and other soil material from mining and quarrying (26 million tonnes in all), straw and manure from agriculture (25 million tonnes) and wood felling

waste from forestry (20 million tonnes). Altogether nearly 17 million tones of waste were generated in manufacturing in 2000, of which the largest quantities were waste wood and bark, slag from the basic metal industry, especially gypsum, and liquid wastes from the food industry. The annual volume of solid municipal waste amounted to 2.6 million tones. Smaller amounts than those listed above were generated as ash and slag from energy production, construction materials from new building and demolition and as sludge from waste water treatment.

On average, 40 per cent of all the generated waste are recovered by the national economy as a whole. In terms of volume this represents approximately 50 million tones. Wastes like surplus soils from construction, as well as manure and straw, were recovered in large volumes. Manufacturing recovered 67 per cent of its waste, either as energy or as raw material. good waste and the construction and demolition waste generated were recovered in 2000.

Over one-half of industrial waste comes from the forest industry. In 2000, the pulp and paper industry generated 7 million tones and the manufacture of wood products 3 million tones of waste. The next largest generators of industrial waste, in order of generated amount, were the chemical industry, basic metal industry, manufacture of metal products, food industry and manufacture of non-metallic mineral products. Changes in the volumes of waste generated in different industries and in their relative shares were, in fact, surprisingly small in the past decade, and reflected cyclical or output volume variations rather than structural changes in waste generation or production. Especially calculated per capita, the Finnish volume of waste can be regarded as large by European comparison.

Wastes can be classified into three categories: non-hazardous, inert and hazardous. A vast majority of industrial wastes is non-hazardous, in other words not considered hazardous. Inert waste is in practice solid mineral waste, like stone, often deposited in the place of its origin. Calculated using the current definition of hazardous industrial waste, this waste category made up 6.5 per cent of the total volume of industrial waste. Application of the current definition almost doubled the volume of hazardous industrial waste. The biggest generators of hazardous industrial waste are the basic metal industry, manufacture of metal products and the chemical industry. In 2000, the total generation of hazardous waste in industry was 1.1 million tones.

Since 1987 the recovery rate of industrial waste has been going up in Finland by more than

one percentage point per year, on average – from 50 to 67 per cent. Especially well recovered waste types are wood and bark waste, scrap metal. waste generated in the manufacture of food products, packaging waste and sludge from waste water treatment. Roughly 30 per cent, or 4.9 million tonnes, of industrial waste is land filled. Over the past few years, the treatment of industrial waste has undergone a greater change than has its generation.

The main wastes from energy production are ashes from combustion and gypsum from desulphurization. Fly ash accounted for nearly 80 per cent of the ashes. In 2000, the total amount of ashes generated by all combustion plants was 1.2 million tonnes. The amount of fly ash from coal combustion decreased in the past decade, in particular, whereas that from peat combustion has almost doubled from 1992. More than one-half of ash is recovered. It is used in soil structures and as raw material for construction materials. It should be noted that the volume of waste from plants belonging to the energy production industry is smaller than the overall volume of waste generated in thermal processes.

Waste generation in house building totaled approximately 1.4 million tonnes in 2000. The amount includes wastes from new building construction, renovation and demolition, but excludes surplus soils from house building. The distribution of house building waste between new, renovation and demolition building, changed markedly in the past decade, so that the proportion of waste from renovation building increased by 20 percentage points while that from new building diminished correspondingly. In 2000, renovation building generated 800.000 tonnes of waste. Both mineral waste and wood waste made up 36 per cent of the total waste generated in house building.

Approximately 10.5 million tonnes of surplus soils were generated by house building in 1999. Additionally, approximately 20 million tonnes of surplus soil masses were generated in civil engineering, such as road building and harbour dredging. The practice in classifying surplus soils from construction as waste varies by country.

The main municipal waste types are packaging waste, organic waste and waste paper. Nearly 500 kg of municipal waste per capita are generated in Finland every year and this equals the European average. Households generate annually just under 200 kg of waste per capita. Good one-third (39 %) of municipal waste is recovered, while the rest (1.6 million tonnes) is landfilled.

A total of 1.2 million tonnes of packaging

was used in Finland in 2001. Considering that about two-thirds of all packaging is reused, the real annual total volume of packaging waste is approximately 460.000 tonnes. Over one-half of the packaging waste is paper or fibre, although their share of the packaging that is used is notably smaller than this. The rate of paper recovery for recycling is one of the highest in Europe in Finland, approximately 72 per cent in 2002.

Landfill sites are still important waste disposal and treatment places. However, decreasing their number and raising the level of waste treatment on them along with a strong reduction of the volume of landfilled organic waste are common European waste management targets. By the year 2002, the number of operating landfill sites had fallen to 243 in Finland, whereas ten years earlier they had numbered twice as many as this. Operating and closed landfill sites in Finland presently number almost 1.900. A total of approximately 8 million tonnes of different kinds of waste from production and consumption were landfilled in 2000. Approximately 4,9 million tonnes, or 60 per cent, of this total originated from industry.

Expressed in terms of dry matter, the sludge from municipal waste water treatment plants totaled 160.000 tonnes in 2000. The "real" volume, that is the wet weight, of the sludge was approximately 1.1-1.2 million tonnes. Sludge from waste water treatment plants is used for soil improvement in public green area building and agriculture. Under 10 per cent of the sludge was landfilled.

The total amount of hazardous waste generated in 2000 was 1.2 million tonnes. The largest groups of hazardous waste are wastes from the processes of metallurgy and inorganic chemistry, waste oils, solvents, and wastes from thermal processes. Some hazardous waste is treated and recycled by the producers themselves, while some is treated at the national hazardous waste disposal plant or at other hazardous waste treatment plants. A certain amount is also kept in long-term "storage". The amount of hazardous waste received at the national hazardous waste disposal plant exceeded 133.000 tonnes in 2003. Waste oil made up over one-half of this. The thousands of land areas where the soil is graded as "contaminated" are also classified as hazardous waste. However, they are not included in these hazardous waste statistics.

(ID 098) Uvedba sistema door-to-door kot nadgradnja sistema ločenega zbiranja odpadkov

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S ciljem zmanjšanja količin preostanka odpadkov, ki so namenjeni odlaganju na odlagališču nenevarnih odpadkov v Tuncovcu (Rogaška Slatina), smo z julijem 2007 uvedli povsem nov sistem zbiranja odpadne embalaže. Sistem temelji na individualnem pristopu in uporabniku omogoča enostavno, funkcionalno in ekološko dovršeno zbiranje odpadne embalaže na izvoru. Sistem je tudi ekonomsko, socialno in ekološko privlačen tako za uporabnika kot za izvajalca javne službe. Sedanji sistem ločenega zbiranja odpadkov z uporabo zbiralnic in zbirnih centrov ni učinkovit in v bodoče kljub dodatnim investicijam ne omogoča izboljšanja stanja in dosego cilja – odložiti manj odpadkov na odlagališče. Cilj je še toliko pomembnejši iz vidika zapiranja lokalnih odlagališč z letom 2009, saj se bodo poleg obstoječih stroškov pojavili dodatni stroški transporta in pričakovano višji stroški končne dispozicije odlaganja odpadkov. V prispevku zato predstavljamo učinke uvedbe povsem novega sistema ločenega zbiranja odpadkov, ki zaradi sledljivosti količin mešanih odpadkov za uporabnike predstavlja motivacijo za ločevanje odpadkov in uresničevanje načela »povzročitelj plača«.

(ID 098) Introduction of the Door-to-Door System to Up-Grade the System of Waste Separation

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In July 2007 we established a fully new system of collecting waste packaging with the goal to minimize waste materials, which are disposed on the landfill site for non-hazardous waste in Tuncovci (Rogaška Slatina). The system is based on the individual approach and offers the user an easy, functional and ecological perfect collection of waste packaging at the source. The system is economically, socially and ecologically attractive for the user and the public services. The current system of waste separation of using collectors and collection centers is inefficient and does not improve the situation and also does not

help reaching the goal – minimizing disposed waste on the landfill. This goal is also important because of the closure of local landfills by the year 2009. Beside the existing costs transport costs will appear and the expected higher costs of final disposition of waste disposal. In our project we present effects of the introduction of a new separate waste collection. Because of the traceability of the quantity of mixed waste, separation represents a high motivation for users and realizes the principle “the one who causes waste pays”.

(ID 064) Current Status, Problems and Their Countermeasures of Municipal Sanitary Landfills in the Southeast of China

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The southeast of China is the most developed zone with the highest population density in China. It is a very urgent social problem how to treat so large amount of municipal solid waste (MSW). At present, the sanitary landfill is a main way to solve this problem. In this paper, the main environmental geotechnical problems of the current sanitary landfills is analyzed and discussed based on the in-site investigation. In the light of the topographic characters and geological conditions, the sanitary landfill sites can be divided into four types, i.e. hilly, plain, riverine or coastal and mining. Each type of landfill is described and discussed; finally, the countermeasures to solve these problems are put forward.

Session 6. Waste Management/ Sekcija 6. Gospodarjenje z odpadki

(WM/35) (ID 099) Solid Waste Collection & Segregation: Health & Protection Risks of Waste Collector Children in Quetta

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Waste collection is a worldwide affair. The valley of Quetta surrounded by barren hills, once called “Little London”, where streets were not only swept but also washed with water, now facing numerous problems due to the acute shortfall of water and improper waste collection systems. In Quetta waste is mostly manually lift and dump containers into the operational trucks. The solid waste collection in the largest province of Balochistan is only 5% whereas in Quetta city 55% solid waste (Multiple Indicator Cluster Survey-MICS, Government of Balochistan, 2004) is collected and shifted to open landfill site.

In Quetta, the street children (both girls and boys) that collect waste from communal waste bins and waste heaps are mostly belong to very poor families and they contribute economically to their families for survival. These street children collecting waste are contributing the largest share in collection, shifting to the dumping sites / heaps and segregation for the recyclers. They are exposed to foul odours, dust, ants, flies and insects. They also faced health problems that include irritation, chemical burns, and wounds from disposable needles, broken glass, falling objects from overloaded containers and other diseases that may accompany solid waste. Beside all of this, Protection is one of the most important issues as they are vulnerable to mostly emotionally and physically abuses.

As service of waste collection is very important considering the effect of improper waste disposal on human health and natural environment. The street children collecting waste are contributing large share in waste segregation and recycling. These children are also human beings who deserve to be in good health, protection and to live a decent life. Therefore, a survey and interviews based study is conducted on the street children collecting waste and their health n’ hygiene, protection and socio-economic issues for selling to the recyclers to earn their and family livelihoods in and around Quetta city are considered.

(ID 002) Recyclable Potential of Wastes from a Chemical Fertilizer Industry at Onne, Nigeria

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The nature of solid wastes and their leachates from a chemical fertilizer industry located in Onne, Nigeria was assessed to determine its recyclable potential and possible management options in the industry. The study was descriptive and exploratory in design. It involved collection of composite sample of solid wastes from the temporary dumpsite of the industrial complex as well as leachate samples around the same vicinity. The solid waste was characterized physically and chemically into combustible rubbish, garbage, carbon, nitrogen, potassium and phosphorus. Similarly, the leachate was characterized chemically according to standard methods into pH, conductivity, chloride, nitrate, zinc, and phosphate. The results indicated that the waste with a density of 89.1 kg/m³ is richer in combustible matter (45.8%) and has more organic carbon (2.8 ± 0.7 g/100g) and potassium (2.5 ± 0.7 g/100g) contents while the leachates recorded very high concentrations of conductivity (1.97 x 10⁸ µs), phosphate (4.88 x 10³ mg/l) and zinc (74.9 mg/l). This study reveals that the industrial wastes and their leachates have inorganic elements such as potassium, phosphate and zinc, which could be properly harnessed and recycled as a veritable waste management option in the industry.

(ID 007) Municipal Waste Management Disposal Technology at Otamiri River Owerri Nigeria

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Perceived hazards related to waste disposal have led to this study were many people have little confidence in government or industry to preserve and protect public health in the context of waste disposal, waste disposal sites are essential if society is to function properly be it a sanitary land fill for municipal waste an incinerator that burns urban waste as hazardous waste disposed operation for chemical materials. Many waste management programmes procedures involves simply moving waste from one site to another and not really managing it. Waste from urban areas may be placed in land fills, causing new problems while methane gas or noxious liquid while leak from the site and contaminate the surrounding areas. Methane produced from land fills when managed well is a resourced for as fuel. An integrated waste management (IWM) policy concept is advocated I this study this management alternative involves, re-use sources reduction, recycling composting, land fill and incineration and preparation of Biogas. A system design model of the economy showing flow of various grades of resource have been treated of this study. The input-output and waste vectors and the wastivity productivity relationship and methodically presented.

(ID 011) Municipal Solid Waste Management Problem in Portharcourt Metropolis of the Niger Delta Region of Nigeria: the Role of the Public

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Port Harcourt is a city characterized by economic, social and political activities. It is the nerve centre of oil and oil related businesses in Nigeria. This gives rise to a high influx of immigrants into this great city. It is popularly referred to as the treasure base of the nation. Most roads in Port Harcourt metropolis are swept on daily basis and also waste collectors do collect the solid wastes in most parts of the city. This not withstanding Port Harcourt city is still plagued with the problem of solid waste management. This problem is buttressed by the obvious heaps of solid wastes littered over most of the streets

and the major roads of this great city. Due to the health implications associated with poor solid waste management it became necessary to research into the sufficiency of the managerial know how and the hygienic disposal methods for solid wastes produced in this city. Data collection was by field work and structured interview from the management of the state environmental health office and members of the public. Convenient sampling technique was used in selecting the sample for the study. The aim of the study is to establish the problem with solid waste management in Port Harcourt metropolis and proffer useful suggestions that will help in alleviating this problem of solid waste management if implemented.

(ID 012) Health and Safty Risks Amongst the Municipal Solid Waste Collectors in Port Harcourt Metropolis of the Niger Delta Region of Nigeria

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Refuse collectors are those that pick up garbage for deposit at transfer stations or recyclable materials for deposit at existing recycling sites. This task is executed through the use of a truck on assigned routes. In developed countries automated trucks are used using hydraulic lift to pick up and dump trash containers. In developing countries such as Nigeria, the reverse is the case. Refuse collectors in this study area manually lift and dump containers into the operational trucks. Refuse collection is laden with health hazards. They are exposed to foul odours, dust, ants, flies and they get dirty easily even when they wear protective clothing if any (Appendix1B). Other hazards include chemical burns, injuries from disposable needles, broken glasses, falling objects from overloaded containers and the diseases that accompany solid waste. It is a very common sight to see refuse collectors on truck filled to overflowing with solid wastes sitting unsupported on top of the refuse while the truck is moving. The aim of this paper was to explore the work practices, injuries, illnesses, working conditions and other hazards faced by Port Harcourt

municipal solid waste collectors in the course of discharging their duties. The sample for the study constituted of two hundred and seventy nine (279) solid waste collectors selected through convenient sampling technique. Their supervisors also formed part of the sample population. Data for the study was collected through structured questionnaire on Port Harcourt Metropolis solid waste (MSW) workers and oral interview with the aid of trained research assistants. Responses were analyzed using descriptive statistics of frequency counts, percentages and tables. Results revealed that out of the total respondents of two hundred and seventy – nine (279), 73(26.2 %) agreed that their protective equipments were of the right quality and suitable to the task, 31(11.1 %) were undecided while 175(62.5 %) disagreed. This implied that their protective equipments were not of the right quality and also not suitable to the tasks. Qualitative data revealed that not all the workers were given the protective equipments. Physical observation of the waste components revealed broken glasses and bottles, empty tins with serrated edges, broken plates, hypodermic needles and other sharp objects amidst several other forms of wastes. Two hundred and thirteen respondents representing 76.3 % of the total population agreed that they had sustained injuries from sharp objects in the course of packing refuse with bare hands. Only 57(20.4 %) disagreed while 9(3.2 %) were undecided. The study therefore concluded that Solid waste collectors in Port Harcourt municipality experienced different types of preventable hazards inherent in their jobs due to their work practice. The hazards they experienced ranged from injuries of all kinds, musculoskeletal and hearing disorders to respiratory and gastro intestinal tract infections. It was therefore recommended that the workers should be provided with the right protective equipments suitable to the tasks and also monitored to ensure their usage at work. Amongst other recommendations was also the need for periodic health surveillance to detect early signs of disease and also monitor their work ability.

(ID 020) Solid Waste Management in the Construction Industry (A Case Study of Port Harcourt Metropolis)

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The construction industry generates large quantities of waste and contributes to the problems of environmental sanitation in Nigerian cities. Across Nigeria, proper procedures for managing construction waste are absent and collection and disposal are left to developers and their contractors. Solid waste management embraces all administrative, financial, legal, planning, and technological functions involved in solutions to all problems of solid waste. The main purpose of this paper is to examine waste management in the construction industry, using Port Harcourt Metropolis as a case-study. This paper also compares construction and demolition waste management in Nigeria with that in developed nations. The methodology adopted is the questionnaire, which was administered to officials of the Rivers State Environmental Sanitation Authority, Managers of construction sites and government contractors responsible for waste collection and disposal. Findings revealed that construction practitioners do not adopt waste minimization, reuse and recycling strategies and waste is not separated before disposal as it is practiced in developed countries. It was recommended that the government should introduce a disposal tax to reduce the volume of waste generated and encourage reuse and recycling such waste.

(ID 021) Waste Disposal in Low-Income Neighbourhoods and Its Impact on Health: The Case of Port Harcourt, Nigeria

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Port Harcourt, the capital of Rivers State is one of the fastest growing urban centers in Nigeria. This growth is induced by population drift from rural areas in search for employment and greener pastures in the city. The result of this

growth is the development of informal settlements along the water-fronts popularly known as “Watersides” to house these immigrants from the rural areas who are mostly low income earners. These waterside settlements lack basic amenities such as toilets, waste collection points, roads, and water supply. This paper aims at examining the health implications of households and human waste disposal systems in these neighbourhoods. Data for the study was obtained from two informal settlements and one formal settlement namely; Bundu Waterside, Marine Base Waterside and Mile One Diobu. A sample of two hundred and seven respondents was used. Descriptive statistics was used to analyze the data collected.

- The disposal method of waste collected, by land-fill, incineration, etc...

Session 7. Waste Management **Sekcija 7. Gospodarjenje z odpadki**

(ID 014) Upgrading Small Municipal Dumpsite into an Environmentally Sustainable Landfill Rationally - Real Case Study

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Few decades ago, common way of municipal solid waste disposal was to bury it into the open dumps. This was a widespread practice even in developed countries, because the environmental consciousness was not yet developed. That time public owners tended to operate their waste disposal facilities as cheaply as possible, which ultimately resulted in certain engineering and operational characteristics distinctive just for these facilities and structures, sometimes called ‘disperse type municipal landfills’. For example, concept of engineered barriers did not apply to them. During the time they were active, the incoming waste was usually bulldozed in the way to result in pretty thick and badly compacted layers. Daily practice of spreading out a thin sanitary cover utilising local soil was nevertheless usually implemented, mainly due to public health concerns.

Surprisingly, some of the already mentioned characteristics seem to be environmentally beneficial under certain circumstances and/or within certain physically controllable settings. E.g., it is a known fact that a typical disperse type landfill body in the form of a heap of waste built up over flat terrain can mineralize relatively fast, which is, coincidentally, in accordance with a sustainable development concept. The waste obviously degrades so fast due to high permeability and flushing capability of the non-compacted landfill body. Such body can typically absorb large amounts of water in its unsaturated zone during the rainy periods and releasing it out only slowly over extended periods of time. This comes from the fact that 1) the top of the open dump usually appears to be only loosely covered

(ID 061) Urban Solid Waste Problem, A Community Based Approach

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Urban solid waste management has become a major concern for the cities and towns of Bangladesh. Municipal services in most cities and towns are already over-burdened, and simply cannot meet the growing demand for municipal services, resulting in unhygienic and filthy living condition in the neighborhoods.

Most local governments and urban agencies have, time and again, identified solid waste as a major problem that has reached proportions requiring drastic measures. We can observe three key trends with respect to solid waste:

- Increase in sheer volume of waste generated by urban residents,
- Change in the quality or make-up of waste generated,

with a permeable, fertile soil layer rather than with an impermeable clay liner, and 2), because the non-compacted landfill body exhibits both, high permeability and high absorptivity/storage capacity for water resulting from its subhorizontally layered structure and extremely heterogenous texture. Primary (i.e., untreated) leachate coming out of such dumps tends to be less loaded with some of the most adverse pollutants when compared to most of the engineered landfills of similar capacity, which is due to the fact that the uncompacted landfill body provides more friendly environment for microbiological life resulting in more complete degradation. Additionally, due to its effective biofiltering/ oxidising capacity, disperse emissions of methane from the open dumps covered with thick layer of permeable fertile soil or compost are typically low, which was recognised by numerous investigations.

In Slovenia, open dumps had to be closed down or upgraded so to comply with the national Landfill of Waste Ordinance, itself based on the European Landfill Directive Act from 1998. This happened in 2004. The common approach in upgrading the existing landfills tended to comprise two steps: some sort of remediation of the already existing waste bodies and setting up brand new, dry type landfills in their immediate vicinity. However, dry type landfills do not fit well into a sustainable development concept and such approach is certainly not the only one which can meet the Slovenian Landfill of waste act requirements. Many positive characteristics distinctive for disperse type landfills can be preserved in certain settings and upgraded so that the landfill interferes with the surroundings more in accordance with a sustainable development ideal. At the same time, investments and operational costs can be reduced.

Small landfill for non-hazardous waste near the town of Ajdovščina was systematically upgraded just in the above mentioned way. It covers the needs (in conjunction with the complementary waste reclamation center facilities) of some 23000 inhabitants as well as those of the relatively large local industry. Some features were developed there which make use of simple and cheap methods and technologies in sophisticated conceptual arrangements exploiting multidisciplinary environmental knowledge, such as:

- quite original water recirculation system used for leachate and run-off water purification, for its removal by means of evapotranspiration, equalization of

uneven water fluxes and to accelerate the rate of waste mineralization,

- reasonable method for disposal of biodegradable monofractions and wastewater treatment plant derived sludge which is in compliance with the regulations and which reasonably exploits synergies which exist when landfill and composting facilities are operated jointly,
- cheap and effective gas collection and treatment system,
- application of plots of ground within the closed, still settling part of the landfill for different waste treatment related purposes, even for setting up outdoor facilities for refuse-shredding, sorting and similar waste materials processing, sparing the environmentally sensible space.

Very reliable and comprehensive presentation about the effectiveness of the geological and/or artificial clay barrier underneath the landfill to attenuate and/or prevent transport of dissolved pollutants subterraneously will be given as well.

(ID 058) Utilization of the German Recommendation E 1-7 GDA in the Classification of the Municipal Solid Waste from the Rio De Janeiro - Brazil

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The following work describes the classification of MSW of the city of Rio de Janeiro according to the established criteria by the German DGGT (1994) E 1-7 GDA regulation. This regulation deals with the identification and description of residues according to the interesting aspects of waste mechanics. These information will give to the environmental control agency and the companies responsible for the final disposal of the residues a first information about the geotechnical characteristics of the materials.

(ID 082) Sanacija odlagališča gudrona v Pesniškem Dvoru

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Pri postopku rafinacije olj, ki temelji na obdelavi z žveplovo kislino, nastaja smolnat preostanek imenovan gudron. S takšno obdelavo se ločijo nerazvejane parafinske molekule (željena frakcija) od nezaželenih primesi (aromati, izoparafini, heterociklične spojine). Gudron je zmes tekočih, pastoznih in trdnih ogljikovodikov, ki vsebujejo še prosto in vezano žveplovo kislino.

Rafinerija odpadnih olj v Mariboru je gudron odlagala v okoliške jame, od katerih je največja v Pesniškem Dvoru in je v postopku sanacije. Sanacija obsega izkop gudrona in kontaminirane zemljine, njuno obdelavo in predelavo v sekundarno gorivo (gudron) oziroma v gradbeni material (kontaminirana zemljina), zasutje jame, odstranitev obstoječih objektov in ozelenitev celotnega področja odlagališča.

Predelava gudrona poteka na procesni opremi, instalirani neposredno ob odlagališču. Kisle sestavine se nevtralizirajo z apnom, neaktivni dodatki (žaganje, papirniški mulji ipd.) pa zagotavljajo ustrezno konzistenco (sipkost) produkta predelave. Postopek predelave poteka kontinuirno in semikontinuirno in je podprt s procesnim vodenjem. Plinske emisije (prevsem SO₂) se zajemajo z ustreznim odsesavanjem in vodijo preko pralnika plinov, kjer se očistijo. Po tem postopku pridobljeno sekundarno gorivo bo kot energent uporabljeno v nemški

termoelektrarni, ki kot osnovni energent uporablja premog s primerljivimi lastnostmi. Vzporedno s postopkom predelave je vzpostavljen tudi sistem monitoringa vplivov ne okolje.

Ocenjena količina odpadka, ki ga bo potrebno predelati: 17.000 t gudrona in 8.000 t kontaminirane zemljine.

(ID 082) Renewal of Acid Tar Lagoon Site at Pesniški Dvor

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In oil refinement process, based on the treatment with sulphuric acid, a bituminous residue, called acid tar, is formed. With such a treatment, linear paraffin molecules (desired fraction) are divided from undesired additions (aromatics, iso-paraffines, heterocyclic compounds). Acid tar is a mixture of liquid, paste-like, and solid hydrocarbons, containing free and bound sulphuric acid.

Waste oil refinery in Maribor land-filled the acid tar into neighbouring dumps, the largest of which is at Pesniški Dvor and is in the process of site rehabilitation. The rehabilitation operation comprises the following: digging out of acid tar along with contaminated soil, their indispensable treatment and recovery to a secondary fuel (acid tar) or into the building materials (contaminated soil), on-site burial of the dump, elimination of existing constructions and making the whole dumping site green.

Recovery of acid tar runs on the processing equipment installed close by the waste dump. Acid substances are neutralised with lime, inactive additions (sawdust, paper sludge etc.) providing adequate consistency (flowability) of recovered product. The process of recovery runs continually and semi-continually and is supported by the process control. Gas emissions (especially of SO₂) are taken by means of adequate suction and directed through alkaline scrubber where they are purified. The secondary fuel obtained according to this process will be used as the energy feedstock in German thermal power station, which uses coal as the basic fuel of comparable properties. Parallel to the recovery process, there has also been established the

monitoring system for environmental impacts.

The estimated quantity of waste to be recovered: 17.000 t acid tar and 8.000 t of contaminated soil.

(ID 087) Recovery, Recycling, Reuse & Immobility Technology for Controlling Municipal Solid Waste – An Overview

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Population growth, standard living improvement and industrial activities are increasing, consequently large amount of municipal solid waste (MSW) increase. However, the method of management and control of MSW are not yet effectively controlled and still offer a major problem in the area of environmental geotechnology. This paper presents a critical review of overall problems in four areas including: recovery, recycling, reuse and immobility technology focused on controlling municipal solid wastes. For the immobility further subdivision covers stabilization, solidification as well as landfill technology. In each case, criteria for recovery, recycling and reuse of MSW are outlined. Comparisons of advantages and disadvantages of each case are made in tabulated form. Five areas of MSW are emphasized in this paper as:

- (1) Classification and characterization of municipal solid waste (MSW), also includes radioactive nuclear waste, toxic heavy metals, and scrap non-ferrous metals.
- (2) Closely examines current MSW controlling methods including recovery, recycling, reuse and immobility technology.
- (3) Detailed review of landfill technology includes leachate controlling facilities and also points out the advantages and disadvantages using geotechnical approach for design and construction of landfill.
- (4) Review of current research activities such as: new type of slurry wall made of nanoscale iron particles, homoionic soils and scrap tire aggregates and other environmental geotechnical approaches

for design and construction of landfill, and

Indirectly controlling landfill by reducing incoming wastes dumped into landfill, shrinking the landfill size by using fast-decomposing MSW wastes such as kitchen foods, yard wastes, agricultural by-products and wastes, animal by-products and diapers converting into recoverable and renewable energy such as gasohol and biomass energy. A preliminary plan and laboratory studies are discussed. Benefits and difficulties on various aspects are examined.

(ID 106) Regijski center za ravnanje z odpadki – RCERO Celje

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V Celju je v izgradnji regijski center za ravnanje z odpadki. Načrtovan je za obdelavo odpadkov iz 31 občin celjske regije, oziroma za 250.000 prebivalcev. Obsega objekte in tehnološke postopke za obdelavo odpadkov, odlaganje obdelanih odpadkov in termično obdelavo kalorično bogate frakcije. Posebna pozornost je namenjena zmanjšanju vplivov na okolje in zaposlene.

Izgradnja se je pričela v letu 2006 in bo skupno s poizkusnim obratovanjem zaključena do leta 2010. Posamezni objekti bodo pričeli postopoma obratovati že od leta 2007 dalje. Vrednost projekta je približno 50 mio. EUR. Projekt je sofinanciran s sredstvi kohezijskega sklada Evropske unije.

(ID 083) Izkušnje pri izvajanju projekta Ekoprofit in programa ravnanja z ločeno zbranimi frakcijami mestne občine Maribor

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V letih 2003 do 2006 sta mestni občini Maribor in Gradec skupaj izvajali projekt Ecoprofit, katerega glavni namen je bil nadgraditi okoljsko upravljanje pri gospodarskih subjektih in hkrati z okoljskimi ukrepi doseči izboljšanje lokalnega okolja ter ustvariti finančne prihranke. Med tematskimi sklopi so bili tudi odpadki, pri katerih so bili doseženi veliki finančni prihranki. Medtem je v letu 2005 Mestna občina Maribor sprejela program ravnanja z ločeno zbranimi frakcijami odpadkov, katerega cilj je določiti aktivnosti v zvezi z ločenim zbiranjem odpadkov na izvoru za obdobje 2005 do 2008. Program zagotavlja doseganje nacionalnih ciljev, in sicer: povečanje deleža ločeno zbranih frakcij v skupni količini odpadkov od 27% v letu 2004 na 37% v letu 2008, zbrati najmanj 15 do 20 kilogramov komunalne odpadne embalaže na prebivalca na leto, uvajati ukrepe, da bi do leta 2010 zmanjšali količino biološko razgradljivih odpadkov na 75% skupne količine, proizvedene leta 1995. Izredno pomembno za doseganje dobrih rezultatov na področju ločevanja odpadkov na izvoru pa je pravilno in redno informiranje in osveščanje vseh ciljnih skupin.

In the years 2003 and 2006 the city municipalities of Maribor and Graz (Austria) implemented the project Ecoprofit jointly, the main goal of which was introduction of sustainable development to the enterprise sector as well as achieving savings for companies resulting from the implementation of the environmental measures. One of the aims was reducing the quantity of waste, which was very successful and brought great savings. Then in 2005 the City municipalities of Maribor adopted the programme on Separately Collected Waste Fractions Management, with the objective to determine the activities related to separated collection of waste at the source for the period 2005 to 2008. The programme ensures achievement of national objectives, namely: to increase the share of separately collected fractions in the total volume of waste from 27% (2004) to 37% (2008), to collect at least 15 to 20 kilograms of urban packaging waste per capita annually, to introduce the measures aiming at reducing the volume of biodegradable waste by the year 2010, namely, to 75% of the total volume produced in 1995. Proper and regular informing and awareness rising among the waste producers is considered extremely important for the achievement of good results with regard to waste separation at the source.

(ID 083) The Ecoprofit Project and the Programme on Separately Collected Waste Fractions Management – The Case Study of the City Municipality of Maribor, Slovenia

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Session 8. Waste Management
Sekcija 8. Gospodarjenje z odpadki

(ID 070) Mining Waste of Non-Metal Pits and Quarries in Slovenia

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Mining is an important human activity that creates wealth and supplies materials for maintaining standard of living and for further human development. Mining also has negative impacts on the environment and society; one of them is the production of mining waste throughout the mining cycle, particularly in the mine development and operation/production stage. Due to the EU Directive 2006/21/EC on the management of waste from the extractive

industries and its implementation in Member states, the estimation on quality and quality on mining waste of active non-metal mines in Slovenia was carried out. In the selected mines, mining and processing were examined. With material flow analysis, quantity and characteristics of mining waste were defined for several mines of different commodities. Data on mining waste were afterwards generalized in order to get an overall country evaluation on mining waste "production" of non-metal mines.

Waste produced in mining and beneficiation processes in non-metal mines of Slovenia is either inert or non-hazardous. Most of the mining waste is used for mine reclamation that takes place at the same time as the production phase. The largest amount of mining waste per unit produced is created in dimension stone industry; since the dimension stone production is small, the waste amount is negligible. Large quantities of mining waste are produced in crushed stone and, sand and gravel operation, because aggregate production is huge with regard to other non-metals production in Slovenia. We can therefore conclude that large quantities of mining waste from non-metal mines, which is mostly used in reclamation and for side products, do not represent danger to the environment.

(ID 027) The Impact of Disposal and Treatment of Coal Mining Wastes on Environment and Farmland

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Coal mining wastes is traditionally dumped as a cone-shaped tip in China, which will pollute air, soil and water environment and landscape by dust, leachate, self-ignition and no vegetable cover. Since 1980s, the technique for coal mining wastes disposal has been changing into transporting them directly to fill subsided land for reuse of subsidence land. And now coal mining wastes dump and filling subsided lands are in existence simultaneously. However, the impact of different disposal and treatment of coal mining wastes on environment and farmland has not been probed in detail. Taking Dongtan (DT), Nantun (NT) and Xinglongzhuang (XLZ) Coal Mines as examples, the components of coal mining wastes

and their potential pollution on soil, surface water and ground water are tested in-situ. The results show that contaminants are released after self-ignition and weathering of coal mining wastes, but they are not super the allowance of environmental standards. Even though, we must pay more attention to the transportation and accumulation of these contaminants.

(ID 084) Vzpostavitev zaprtega krogotoka livarskih peskov

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Termit d.d. je rudarsko podjetje za proizvodnjo in predelavo kremenovih peskov in pomožnih livarskih sredstev. Kremenovi peski se v livarstvu uporabljajo za izdelavo kalupov in jeder v katera se uliva kovina. Po končanem ulivanju se uporabljeni pesek zavrže.

Uporabljeni livarski pesek je odpadek livarske industrije, ki se pojavlja v velikih količinah. Letno v slovenskih livarnah nastane več kot 150.000 ton odpadnih livarskih form in jeder, kar predstavlja livarnam veliko ekološko in tudi finančno breme. Večina tega materiala, je do sedaj končala na deponijah, za katere vemo, da se nezadržno polnijo.

Na drugi strani pa rudarsko podjetje Termit za sanacijo svojih odkopnih jam potrebuje ogromne količine primerne materiala.

S ciljem rešiti ta dva problema smo razvili tehnologijo s katero iz odpadnih livarskih peskov s pomočjo različnih dodatkov ustvarimo umetno pripravljeno zemljino, ki nam omogoča lažjo, hitrejšo in kvalitetnejšo sanacijo in rekultivacijo izkoriščenih delov odkopa, livarnam pa rešuje problem odstranjevanja uporabljenih livarskih peskov.

(ID 084) The Innovative Approach toward the Closure of the Life Cycle of Quartz Sand

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Termit d.d. has developed an innovative approach toward the closure of the life cycle of

quartz sand to be used in foundry processes. A carefully planned "cradle to grave" approach is adopted in the novel process, which can be divided into the following six sub-processes: a) extraction of virgin raw material for the production of quartz sand from open mining pits; b) processing of the raw material to obtain the quartz sand; c) use of quartz sand for core production in foundry industry; d) collection of the used quartz sand from the foundries; e) use of waste sand and waste materials from other industries, such as paper sludge from paper mills, as constituent materials in the production of a new product with added value - fertile artificial soil; and f) use of the new product (fertile artificial soil) for remediation of degraded landscape, e.g. damaged landscape caused by open pit mining and all other space planning measures where vegetation growth is required (e.g. slopes along roads, quarries, ...). The last sub-process closes the life cycle of the waste foundry sand.

drugs for diminishing the negative effects of the disorder in the pharmaceutical industry and in the healthcare are subjected to rigorous efficiency analyses, no such can be said for the food additives which are obtained on the free market. In such food additives which are offered to help inhibiting and diminishing the effects of osteoporosis, calcium is bound in fossil corals and in calcium carbonate.

Is there a possibility that the commercial food additives contain powdered reef limestone also known as baghouse limestone fines, which is being taken into bag filters at dedusting processes, instead of the questionable decalcinated fossil coral and calcium carbonate? And even so, how do they – from the point of physical and chemical properties – differ from the varieties of calcium binding limestone from the success promising food additives?

(ID 080) Baghouse Fines of Coralline Limestone or Fossil Coral with Calcium Carbonate - Results of Preliminary Research

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Osteoporosis is one of the more common disorders in the developed countries. Despite the known pathological condition an effective treatment of the disorder other than calcium administration is still unknown. Whereas the

(ID 065) Using Municipal Waste to Improve Soil Fertility in Jos Area, Nigeria

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Many of the farmers practising arable agriculture within and around Jos believe that the soils in the area are declining in productivity as a result of annual application of mineral fertilisers. It has been noted that some of the mineral fertilizers being applied have acidifying effects on the soils. Therefore, the application of organic fertilizers is now gaining popularity. Farmers now apply more of town waste in combination with poultry droppings and/ or cow dung. Therefore, the objectives of this study are: to identify the various management practices and soil types used; and to determine the effects of municipal waste application on soil properties. Field observations and measurements, as well as administration of well structured questionnaires were employed in capturing qualitative land use and soil management data while standard procedures were applied in soil data gathering. Crops grown include: lettuce, cabbage, carrots, onion and spinach, among others. Hand tools are used for land preparations. Both local and improved seed varieties are sown. Mixed cropping and crop rotation are common while monoculture is seldom practised. Though the farmers apply inorganic fertilizers, much more attention is paid to the

application of town waste with poultry droppings and / or cowdung. The types of soil found are Inceptisols, Alfisols and Mollisols. The results of soil analysis show that application of town waste has really modified the soil conditions. The surface soils in some areas have become very dark, classifying the soil as Mollisols. The levels of organic matter, total nitrogen, exchangeable bases and CEC have been greatly enhanced. However, the levels of some of the trace elements have also increased too.

(ID 067) The Challenges of Municipal Solid Waste Management in Nigeria

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Waste management plays an integral role in human activity and societal development. Waste management does not only involve rational decision making about whether to bury, burn, recycle or produce less waste, it must bring to bear the impacts to health, safety and environment. Assessing the costs-benefits implications of various waste management policies and project is equally a complex business involving numerous, interconnected economic, social and biological components. The challenges to effective municipal waste are not simply lack of policy, but lack of infrastructure, education, social awareness of problems and solutions, and lack of committed institutions promoting sustainable actions.

This paper provides a comparative analysis of various waste management options, as well as discusses the health and environmental impacts of municipal solid waste and the challenges confronting municipal solid waste management in Nigeria. It recommends that government should encourage private investment in this sector by providing land for the construction of basic waste management infrastructure as well as providing enabling legislation that would encourage investment in waste management.

Session 9. Waste Management
Sekcija 9. Gospodarjenje z odpadki

(ID 033) Stability Assessment of Paper Sludge Landfill Cover Barrier

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Use of the paper sludge as the barrier material in landfill capping system has gained some attention since early 1990's. The use of paper sludge as the hydraulic barrier material in landfill covers is a innovative way to recycle residuals of paper industry. Some slovenian landfills consider use of paper sludge in capping systems as an alternative to, or to improve the performance of, a compacted clay liner, as part of an engineered barrier layer in the landfill cap. Paper sludge may be more appropriate for some site-specific circumstances due to the nature, availability or practicality of using clay materials, the nature of the waste, or climatic conditions. Assessment of paper sludge as landfill cover liner and landfill capping stability is a key element of this paper. Both stability and integrity of the paper sludge cover liner were assessed in order to demonstrate performance of the barrier system during the design life of the facility. For stability assessment was used computer program Plaxis. Results given by stability assessment, which are presented and commented in the paper, were finally the basis for the design of a long term landfill capping system.

(ID 089) Reliability of Modeling Results of Future Final Cover Performance

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One of the most important questions in modeling of natural processes is to what extent our model reflects the actual field conditions and what is the reliability of its results. Uncertainty arises from a series of assumptions, simplifications, estimations and interpretations of measurements used in attempts of predicting future states. Calibration of models of existent objects is done by fitting model results on measured data, and the model is verified when its predicting ability is confirmed. However, in optimization of future objects these main confidence building methods are not available, so the reliability of the model has to be established by other means. One of the ways to do this is the intercode comparison where results of one model are compared to results of another mathematical representation of the same conceptual model. Such study was done in the case of future final cover performance assessment in mill tailing landfill Boršt, Žirovski vrh.

Boršt landfill is located near the recently closed uranium mine Žirovski vrh in a location which can hydrogeologically be characterized as low permeable. However, that doesn't exclude the possibility of occurrence of groundwater, which could especially be seen in 1995, when a vast amount of groundwater triggered a landslide of the landfill and parts of its surroundings. Since then, several hydrogeological studies were carried out one of which is the final cover optimization which is presented here.

Water balance analysis was performed with two commercial tools, namely HELP model and HYDRUS-2D. The former is a standard tool for hydrogeological evaluation of landfill performance and the latter is a numerical tool for groundwater flow and transport in unsaturated and saturated zone. The optimization was done in three steps: optimization of the cover design, material selection and sensitivity analysis for certain parameters.

Even though HELP and HYDRUS-2D use substantially different approach the results of the two models are generally consistent on relative scale where different designs and materials show same proportions as well as on absolute scale although to a somewhat lesser extent. Good agreement between the results and the completed sensitivity analysis give an extra information on future final cover performance and add to reliability of the performed predictions.

(ID 086) Brez fosilnih energetskih virov za cementno industrijo – od vizije do uresničitve

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Za uporabo nadomestnih goriv (NG) v cementni industriji morajo biti ne glede na direktive in gospodarske aspekte izpolnjene tri predpostavke:

1. cementarna mora biti tehnično sposobna izkoriščati NG
2. primerni odpadki morajo biti na tržišču na voljo v zadostnih količinah
3. predpriprava teh odpadkov za NG s primerno kakovostjo je tehnično izvedljiva

Tem višja je želena NG stopnja, toliko težje je izpolniti vse tri predpostavke. Uresničitev je zelo kompleksna in je predstavljena na podlagi faznega modela. Veliki cilj „100% uporaba NG“ se zdi gledano iz današnjega vidika v nekaterih evropskih regijah vendarle dosegljiv. Za vse področje Evrope ta cilj srednjeročno ni izvedljiv predvsem zaradi neizpolnitve zgoraj navedenih točk 1 ali 2.

(ID 086) Zero Carbon Coal in the Cement Industry – From a Vision to Realisation

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For the utilization of alternative fuel (AF) in the cement industry, besides legal and economical framework three major fulfilments must be met:

1. Cement plant can utilize AF from technical side
2. Adequate waste streams are available on the market in sufficient quantity
3. Production of high quality AF out of waste is technically possible

The higher the substitution rate of the AF, the more difficult it gets to meet above fulfilments. The realisation is very complex and will be explained by the phase model. The main target of 100% substitution rate in Europe seems to be fulfil able. Area wide throughout Europe mid term not achieving point 1/2.

The time frame of a typical cement plant is a few decades, thus existing plants must be adapted to the utilization of AF. Based on the hypothesis that point 1 and 3 are fulfilled, the significant factor is an existing waste market.

According to the phase model of the waste service industry, the evolution of the waste market in a country is not only based on technical innovation but also on other indications such as gross domestic product, level of industrialisation as well as political/ecological movements and others.

Normally the development of the waste market occurs in different phases, currently 5 phases beginning with non organized illegal dumps as phase 1 and closed recycling system as phase 5.

In a cement plant there are basically two possible ways of utilization of alternative fuels. On one end of the cement kiln, the main burner or on the secondary end, the calcinatory or cyclone end.

Phase 1 “Non organized illegal dumps”:

Phase 2 “ordinary landfilling”:

The oldest and easiest way to utilize AF is the use of whole tires on the calcinatory side, which usually starts in phase 2, also called “ordinary landfilling”. Besides the fact that usually there are not enough used tires on the waste market to supply all cement plants, the limit of energy substitution is also limited to approximately 40% due to the total energy input on the secondary end.

Significantly more difficult is the utilization on alternative fuels on the main burner side, first because of a minimum energy input of at least 22 MJ/kg (lower calorific value), second because the alternative fuel must have a very small particle size and free of harmful materials so that all particles are incinerated in the flame and do not fall on the ground of the cement kiln where it can lower the quality of the clinker.

Phase 3 “separate collection phase”:

In phase 3, also called separate collection

phase, the most interesting AF for the cement plant is waste oil on the main burner. But there, similar to the tire problem from above, the available quantity of this alternative fuel is also limited on the market and existing quantities are recycled more often (waste oil recovery). In this phase normally the utilization of solid shredded fuels (SSF) is started, mostly coming from non recyclable plastics, reject materials and others.

Phase 4 “recycling solutions”:

In phase 4, “recycling solutions” countries, such as currently Italy, Czech Republic and Slovenia, high calorific fractions are started to be extracted mechanically from urban and industrial waste streams. A problem that usually occurs with utilization of that type of material is the high chlorine value, causing difficulties in the cyclones due to mineral deposits through chemical reactions. At a certain substitution rate a chlorine bypass has to be built in order to deal with the chlorine input.

Phase 5 “industrial waste recovery”:

In the last phase as known by today there are sufficient quantities of high calorific fractions on the waste market especially from urban and industrial waste streams. In this stage, especially with substitution rates higher than 70% it gets really difficult to move towards 100% substitution rate, despite utilization of chlorine bypass in the cement plant and infrared technology at the AF production plants. To reach a 100% substitution rate the only realistic chance is to completely reconstruct the calcinatory/cyclone part of the cement plant. A showcase in that concern is a cement plant in Rohoznik, Slovakia with a very innovative technology called the “hot disc system”. With this technology a very broad range of waste streams can be co-incinerated, additionally the high calorific fractions medium calorific fraction, also called fluidized bed fraction can be utilized.

This way the vision of 100% substitution rate in a cement plants is not only realistic but already on the way to being reality.

(ID 095) Možnosti uporabe zemljin za izboljšanje ekološkega stanja tal

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Med prioriteta področja, ki jih v svojem programu za uvajanje in spodbujanje okoljskih tehnologij poudarja EU so odpadki in zaščita tal. Predstavljen članek obravnava možnosti uporabe zemljin zemeljskih izkopov in nenevarnih odpadkov iz gradbeništva, industrije in komunale v sestavi z zemeljskimi izkopi kot t.i. umetno zemljino. Z uporabo umetnih zemljin pri izgradnji protihrupnih nasipov ob avtocestah, sanaciji opuščenih gramoznih jam in peskokopov, odpravljanju površinskih posledic rudarjenja, nasipavanju nekvadratnih kmetijskih površin in izgradnji novih rekreacijskih površin se na izhodiščnem degradiranem območju ob upoštevanju predstavljenega v članku izboljšuje ekološko stanje tal ob hkratnem ustreznem ravnanju z določenimi odpadki, ki jih tako ni potrebno odložiti na za to potrebna odlagališča.

(ID 095) Possibilities of Environmental Improvements of Soil Condition with the Application of Excavated Soils and Artificial Composed Soils

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Waste management and soil protection strategy are among the priority of EU policy for stimulation and implementation of the environmental technology. This paper is focused on the potential for environmental improvements of disturbed soils with the application of the excavated soils or non-hazardous waste from different industries (building industry, foundry and wastewater treatment), which mixed with excavated soils generates the artificial composed soils. Potential uses for artificial composed soils include dykes alongside the highways, restoration of abandoned gravel pits and stone-pits and

building new areas for recreation purposes on subsided or damaged areas.

(WM/32) (ID 096) Doseganje posebnih lastnosti betonov z odpadnimi materiali

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Veliko število odpadnih materialov, oziroma stranskih industrijskih produktov se že vrsto let uporablja v sodobni tehnologiji betona, kot mineralni dodatki ali kot polnila – agregati, ki delno ali v celoti nadomestijo naravni kameni agregat. Po SIST EN 206-1:2003, točka 5.1.6 veljata kot splošno primerna za uporabo v betonih mineralna dodatka tipa II: elektrofilterski pepel (EFP), ki je skladen s SIST EN 450 in mikrosilika, ki je skladna s SIST EN 13263. V referatu bomo na kratko podali nekaj primerov uporabe obeh mineralnih dodatkov, s katerima lahko dosežemo betone visokih zmogljivosti. Poleg tega bomo podali in obravnavali rezultate preiskav betonov z agregatom iz žlindre (iz proizvodnje ferokroma po karbotermičnem postopku), s katerim dosežemo visoke trdnosti, žilavost in odpornost betonov proti obrabi z brusom. Zelo zanimiv beton glede na dobljene lastnosti nastane z dodajanjem granulirane gume, pridobljenega z drobljenjem starih avtomobilskih gum. Ugotovili smo precej velik vpliv dodane granulirane gume na povečanje podvodne abrazijske odpornosti betona. Povprečna globina abrazijske se je zmanjšala za trikrat.

(ID 096) Achievement of Special Properties of Concrete with Waste Materials

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Large numbers of waste materials or industrial by-products, respectively have been in use in recent concrete technology for many years past. They can be used as mineral admixtures or as a filler – aggregates, which replace natural stone aggregate partially or on the whole. Mineral admixtures type II: fly-ash, conformable to SIST EN 450 and silica fume, conformable to SIST EN 13263 valid as appropriate in generally for use in concrete in accordance with SIST EN 206-1:2003, item 5.1.6. In the paper, we shall instance, in a few words some applications of both mineral admixtures. We can achieve high performance concrete by use of both these admixtures. Furthermore, we shall give and discuss the results of investigations of concrete with slag aggregate (which is waste from ferrochromium production). We achieve with it high strengths, toughness and resistance of concrete against wear with grinding. Very interesting concrete in regard to obtained properties originates with addition of granulated rubber, made by crumbing of waste car tires. We established significant influence of added granulated rubber on increase of underwater abrasion resistance of concrete. Average abrasion depth has been decrease for three times.

(ID 073) Environmental Risk Assessment of Organophosphorus Pesticides in the Southern Coastal of Caspian Sea

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Environmental risk assessment is an estimate of the likelihood or probability of an adverse impact on the environment resulting from human activities. In reality using this method, effects and risks involved with the presence of hazardous chemicals in environment are identified, their effects are assessed and if possible, different approaches are recommended for risk communication and risk management. In doing so, first the geographical conditions, agricultural lands and various types of soil in southern coasts of Caspian Sea were investigated. At the same time different varieties of living organisms at Caspian Sea which consists of various mammals, birds, fish and marine invertebrates were identified and also results of investigations on the levels of organophosphorus pesticides in the water of various rivers flowing into Caspian sea were used. These determinations were performed using GC/NPD. Malathion, Diazinon, Fenitrothion and phosalone were investigated in different stations along the rivers.

The results indicate that if considering only the stability of these pesticides, due to being unstable at the PH of these river waters, they have a low risk in this area on the living organisms. However, Diazinon was seen in these rivers in spring and summer at higher levels than the recommended values. These pesticides are not stable in the soil of this region and after entering the soil, due to evaporation, chemical and microbial activities are degraded. On the other hand, mobility of these pesticides in sand is higher.

The probability of risk (high, medium and low) in three provinces of Caspian Sea, namely, Gilan, Mazandaran and Golestan were evaluated. Using the collected data and information, Mazandaran province has more varieties and number of living organisms, it has a sandy and soft sedimented soil in which the pesticide has higher mobility, and the probability of reaching different sources of water is higher. Also this region has higher levels and varieties of agricultural land and crops. Therefore, Mazandaran province has been identified as a region with a high risk for organophosphorus pesticides, mainly Diazinon.

Gilan and Golestan provinces with lower varieties of living organisms, higher varieties of soil type and lower levels of agriculture compared with Mazandaran, are regions with medium and low risk levels respectively. Therefore, it is recommended that we reevaluated the use of Diazinon in Mazandaran province and have a stronger control on it.

Session 10. Waste Management
Sekcija 10. Gospodarjenje z odpadki

**(ID 085) Izboljšanje stanja okolja ob
regijskih odlagališčih
komunalnih odpadkov**

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Večina novih regijskih centrov za ravnanje z odpadki v Sloveniji nastaja ob že obstoječih odlagališčih ali drugače degradiranih okoljih. Novi objekti so načrtovani po vseh evropskih standardih tako, da njihovo delovanje ne bo povzročalo prekomernih emisij v okolje. Problem pa so stara odlagališča, ob katerih se novi objekti gradijo. Ta zaradi neurejenih razmer v preteklosti motijo bližnje prebivalce in vzpodbujajo njihov odklonilen odnos tudi do postavitve novih objektov. Zato je ob postavitvi novih objektov nujno izboljšati in sanirati stanje starih objektov.

Izkušnje v tujini kažejo, da je možno procese razgradnje že odloženih odpadkov pospešiti in s tem vplive starih odlagališč na okolje bistveno zmanjšati.

Stara odlagališča je možno urediti kot bioreaktorje, kjer z nadzorovanim procesom prežračevanja v bistveno krajšem časovnem obdobju dosegamo rezultate dokončne razgradnje ostankov komunalnih odpadkov. Emisijski potencial iz bioreaktorjev se v teku procesa znatno zmanjša. Postobratovalno obdobje takšnih odlagališč pa je bistveno krajše.

**(ID 088) New Generation Slurry Wall for
Controlling Leachate Leaking
from Landfill Site**

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This paper present a new type of slurry wall. The material used in the wall consist of three basic material element mixed homogeneously with water into one system. These three materials are: (a) fine-grained tire aggregate, (b) nanoscale iron particles, and (c) homoionic modified soil, mixed with water to form a slurry-type material. The major purposes of this new type of slurry wall are both that fine-grained tire aggregate and nanoscale particles have the ability to stabilize and/or decontaminate hazardous/toxic substances in the ground soil at in-situ condition, and the homoionic modified soils can control soil's hydraulic conductivity, shear strength, compressibility, sorption characteristics, etc. by manipulating ions in the soil. The main uses of this new generation slurry material are to improve the effectiveness of current conventional hazardous control facilities such as landfill liners, top seals and barrier walls. In addition, this type of slurry can also be used to seal existing cracks and repair premature or progressive failures.

This is an ongoing research project. This basic and fundamental of the new generation of material system have been explained in previous publications. In this paper, focus is placed on the further laboratory studies, further refining the in-situ measuring apparatus and larger scale field investigations into the effectiveness of the new generation slurry material systems.

**(ID 028) Experimental Study on
Permeability and Its Changing
Regulation Regulation of
Drainage Layer in Waste
Sanitary Landfill**

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As landfill site working, biochemical process and seepage of leachate always influence on and change the permeability of drainage layer. By means of laboratory experiments, selecting and using 8 kinds of granulometric composition sands and gravels as drainage material of drainage layer, permeability and its changing regulation of drainage layer in waste sanitary landfill were deeply studied. The experimental researches show the following: Effective particle size has important influence on the changing rate of permeability coefficient and drainage porosity. Leachate water quality and ions content change greatly when leachate seeps through the drainage layer consisting of sands and gravels, that is, all parameters of effluent leachate, including COD, Ca^{2+} , Mg^{2+} , TVFA, total rigiditytotal alkalinity, NH_4^+-N , TSS as well as VSS and so on, decrease in some extent and present similar variation tendency with time, except for pH values increasing a little; Meanwhile, changing regulation of leachate water quality proves to be irrelevant with granulometric composition of drainage media during seeping; Calcium carbonate and silicon dioxide are of major compounds of the clogging matter generated by leachate seeping in soil pores, and Ca, Si, Fe, Mn, Zn, Mg are of main elements; The components and their relative contents of the clogging matter are independent of granulometric composition of the drainage media, but the larger effective particle size is, the more generation gross and uniformity of distribution of the clogging matter are; It is the main reason for deducing permeability of drainage layer that mineral salts and biomembrane are generated in drainage media pore from chemical process of leachate, biomembrane growth and solid suspended sedimentation. Based on the result of laboratory experiments, the clogging model reflecting leachate water quality parameter (COD_t) influencing on drainage layer permeability and drainage porosity, as well as the function

concerning drainage layer permeability coefficient, drainage porosity and effective particle size, were set up.

(ID 090) Recent Monitoring Results of Landfill Groundwater Interaction – Case Study from Slovenia

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After the implementation of new landfill legislation in year 2000 many new activities had been started in Slovenia to minimise impact of industrial and municipal landfills on the environment. One of the key activities was establishing groundwater monitoring network around several existing landfills and also for proposed sites. In the paper an overview of seven years experiences in planning, designing and construction of groundwater monitoring network as well as first results of these activities are presented. Based on these results groundwater landfill interaction characteristics are given as descriptive statistics. Monitoring results are shown also as aggregated data. Problems encountered during the monitoring establishment are also briefly presented.

(ID 105) Hidrogeološki monitoring olagališč na krasu

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V zadnjih letih je bilo izvedenih več sledilnih poskusov v okolici odlagališč na krasu z namenom določiti smeri in značilnosti toka podzemne vode z območja za določitev vpliva odlagališča ter za določitev učinkovitega programa za monitoring kakovosti podzemnih vod na vplivnem območju odlagališč točk monitoringa. V članku so na kratko opisani rezultati sledilnih poskusov treh odlagališč, in sicer Mala Gora pri Ribnici, Mozelj pri Kočevju ter Sežana. Globina nezasičene cone je na območju odlagališč Mala Gora in Mozelj okrog 100 m, medtem ko je na območju odlagališča Sežana 200 m. Tok skozi nezasičeno cono značilno vpliva na transport onesnažil, zato so se izvedli sledilni poskusi z injiciranjem sledila na površini za določitev vpliva odlagališč na podzemne vode. Sledilni poskusi so bili izvedeni v stanju visokih vod z namenom simuliranja ekstremnih pogojev.

(ID 097) Stability Properties of Biosludge-Wood Ash Composites

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Large quantities of biosludge are generated at biological water treatment plants of paper industry. They are predominantly composed of microbial biomass, with minor portions of other inorganic and organic solids. Typically they have very low solids content and behave as liquids which makes them rather problematic for any direct reuse. On the other hand substantial amounts of ash are released during residual wood and bark incineration for energy production. Appropriate combinations of both waste products can be efficiently utilized as secondary raw materials providing that they exhibit convenient physico-chemical properties and are sufficiently resistant to biodegradation. Mixtures containing different portions of secondary biosludge from 100 % recycled paper production and wood ash (30:70 and 40:60) were prepared. They were

analyzed for their chemical and biostability properties as fresh and in different time intervals during one year period of ageing in anaerobic conditions. Dry matter and ash contents were determined and water leachates prepared according to the DIN 38414-S4 standard method. Conductivities, pH, redox potentials and TOC values were measured in water extracts as well as concentrations of different ions (NH_4^+ , Cl^- , SO_4^{2-} , PO_4^{3-} , NO_3^- , CO_3^{2-}), heavy metals (Cu, Cr, Zn, Pb and Cd) and organic acids (formic, acetic, propionic, butyric, glycolic and lactic). The latter are metabolic products of microbial degradation of organic materials. High concentrations of released acids signify substantial biodegradation and usually simultaneous emissions of bad smell. Ionic species and organic acids were determined by ion chromatography (IC) while heavy metals were analysed by atomic absorption spectroscopy (AAS). The results indicated that composite mixtures behaved differently from their constituents. They developed some convenient properties such as mechanical firmness due to relatively large inorganic portion and biological stability due to highly alkaline pH value. TOC values varied with time while the concentrations of most leached ions were quite low and decreased with time. On the other hand amounts of released volatile acids slightly increased meaning that some biodegradation was in progress however there was no emission of bad smell during the time of experiment. According to the results of chemical analyses of fresh and aged composite mixtures it can be justifiably concluded that those ones containing higher portions of ash (70 %) have convenient physico-chemical and stability properties to be used as building materials for different purposes however their geotechnical properties still have to be tested. By transformation of generated industrial waste into useful products serious ecological problems can be solved and more efficient waste management achieved. At the same time new products are obtained which may replace valuable natural raw materials in numerous practical applications.

**C. ENVIRONMENTAL
GEOTECHNOLOGY/ OKOLJSKA
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**Session 11. Environmental Geotechnology
Sekcija 11. Okoljska geotehnologija**

(ID 062) Site-Specific Distribution Coefficients for Preliminary Modeling Purposes

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Work was performed to generate site-specific distribution coefficient (K_d) values for possible use in groundwater modeling at two different landfill sites (denoted herein as Site 1 and Site 2) for an electric utility. While such coefficients are applicable only for the conditions under which they are generated, they are nonetheless useful in making preliminary assessments. Batch sorption experiments were conducted in consistence with procedures described by the U.S. Environmental Protection Agency. Twenty different soil samples were mixed and shaken with aqueous concentrations of constituents determined to be of concern, namely, arsenic (As), barium (Ba), boron (B), cadmium (Cd), chromium (Cr), fluoride (F), lead (Pb), mercury (Hg), nickel (Ni), selenium (Se), silver (Ag) and sulfate (SO_4). Three soil to solution ratios were investigated with 50 mL polystyrene tubes: 1:5, 1:50 and 1:500. These ratios were sufficient to produce measurable K_d values for virtually all soil samples and contaminants of concern. For Site 1, boron shows the least adsorption ($0 \text{ mL/g} < K_d < 3,75 \text{ mL/g}$) while fluoride shows the highest ($64 \text{ mL/g} < K_d < 1.167$

mL/g). Similarly, for Site 2, boron also shows the least adsorption ($0,19 \text{ mL/g} < K_d < 4,98 \text{ mL/g}$) while lead shows the highest ($K_d > 1000 \text{ mL/g}$). Specific distribution coefficients for each contaminant and soil sample are presented with the primary purpose of contributing to the global database.

(ID 041) Numerical Simulation on Resisting Seepage Capacity of Water Resisting Key Strata in Mined Rock Mass

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In many Chinese mining areas, the prevention and cure of water disaster bring about great economy and environment burden, however, lack of water is an another serious problem over there. This study objective is to exploit both coal and water as resources together, and this is one of the important green mining technologies.

Many researches have been focused on structural key strata which play a main part in bearing the overlying load and controlling the failure structure of mined overlying rock mass. The definition of the water resisting key strata is given according to the analysis of the relationship between it and the structural key strata.

The water resisting key strata are almost composite rock strata, and its resisting seepage capacity is simulated by the code RFPA^{2D}. The plane strain model of water resisting key strata in mined rock mass is built. Five calculation schemes are designed based on the corresponding five constituting patterns of the composite rock strata.

The failure rules, cracks distribution and the seepage passages of the five schemes are obtained from the calculated results directly. After analyzing the seepage and distribution characters of the composite rock strata in each scheme, the

capability of resisting seepage can be compared, and the best constituting pattern of the water resisting key strata is found.

The analysis results are beneficial to estimate whether the mined rock mass can form the water resisting key strata. It's very useful to guide the waterproof mining, and has been successfully applied in some mining areas.

(ID 101) Land Use and Groundwater Management Conflicts

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Integrated water resource management has to balance groundwater protection requirements with a variety of demands for land-use activities in the sense of sustainability. This is difficult to achieve in practice. This complex issue can be supported by Spatial Decision Support Systems (SDSS), in which legal frameworks and socio-economic aspects with emphasis on land-use activities will also be implemented. A decision-support system (DSS) is comprised of specialised databases (including GIS), knowledge base and interactive modelling. Basic work for such a SDSS has been done within the transnational and interdisciplinary project KATERII (Karst waTER research project), supported by the EU INTERREGIII B CADES programme, involving co-operation between institutions from Austria, Croatia, Italy and Slovenia. The major studied land-uses in four pilot areas were summer and winter tourism, settlements, transport, forestry, agriculture and pasture management. In the paper methodological aspects for SDSS will be presented, mainly focused on knowledge base development.

(ID 032) Analysis of Water Insulating Effect of Water-Resisting Key Strata in Floor

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An abundant supply of water in Ordovician limestone is a big hidden trouble in safety production in coal fields of north China. The water-burst from floor above the confined aquifer is closely related to the water insulating effect of the water-resisting strata. To predict exactly the failure and damnification depth of the key strata (KS) in floor and to analyze the insulating effect of the KS can provide a theoretic reference for the safe mining above the confined aquifer. Based on the concept of water-resisting key strata, the mechanics model of the key strata is established according to the structural characteristics and the mechanical properties of the floor rock layers of the working face in a particular coal mine. The characteristic of the deformation, the failure, and the water seepage is simulated by using the rock failure process analysis (RFPA2D), obtaining the corresponding distribution of stress, deformation, the flow volume and the developed depth of the fractures induced by mining. The results can be a good guidance in understanding the water insulating effect of the water-resisting strata and in effectively predicting the water-burst from floor.

(ID 043) The Application of the Quantification Theory in the Danger Assessment of the Mine Flooding

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Hundreds of mine water-inrush accidents have happened since 1950 in China, which submerges the working faces, even the whole coal mine, and causes enormous economic losses. Especially the accident happened on June 2nd, 1984, in the FanGezhuang Mine, in Kailuan,

brought water inflow about 2.053m³/min and over 0,5 billion yuan loss. It is reported that there are 285 out of the 601 state mines. have the dangers of water-inrush. With the coal mining depth increasing, water pressure is being greater, thus the fatalness and hazardness of water-inrush become more and more serious. The water-inrush from mine not only leads to the exhaustion of water sources of the mine areas, but also destroy the environmental destruction around mine areas. The mine water-inrush problem has been one of the most serious problems which influence the coal mine in safe production. Only the reasonable forecasting of the water-inrush danger has been taken, the pointed and effective steps can be taken and then the accidents can avoid. Thereby, this paper investigate the problem of the danger forecasting about the mine flooding based on the quantification theory (model II), and establish the forecasting model, which develop a new method to the safety assessment of the coal mine.

(ID 034) Application of Mine Transient Electromagnetic Method in Forecasting Goaf Water

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The principle of mine transient electromagnetic method (MTEM) is introduced. The method was used to forecast the goaf water in the course of the No.2 main return airway driven in a coal mine. The results show that the position of the goaf water can be found out accurately and rapidly by MTEM, the operation is convenient and it can be applied to do the real-time prediction continuously, the qualitative analysis of the water can be done, but the quantitative analysis cannot, the abnormal area is larger than the real region filled with the water in the map of the apparent resistivity isoline, the data of the side wall of the drift is influenced easily by the blotting with wire

mesh and the blind zone in short distance cannot be avoided.

(ID 051) Bolting Support of Roadway in Fully Mechanized Top-Coal Caving Face

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This paper aims to introduce bolting support of roadways in fully mechanized top-coal caving faces under specific geo-mechanical conditions. With the change of roadway layout and mining environment, support of entries becomes complicated, especially when meeting the following case: solid roadway, static gob-side entry with a narrow pillar reserved in between and gob-side entry driving head-on adjacent advancing coalface occur one after the other. Corresponding bolting supporting principle and rational supporting technology were put forward. Meanwhile the special structure of surrounding rock of gob-side entry and its failure pattern were explored. Lastly supporting effects were demonstrated by an engineering instance.

(ID 052) Two Case-studies of Roof Fall Accidents in Coal Roadway: Occurrence Mechanical Analysis and Preventive Measures

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Two cases of roof fall accidents in coal roadway were described in this paper. Based on analysis of specific support modes and site observation, mechanical model were set up to locate the causes of the accidents. Then the paper ends with enumeration of preventive measures.

Session 12. Environmental Geotechnolgy **Sekcija 12. Okoljska geotehnologija**

(ID 022) Application of Industrial Ecology in Recycle Economy of Mining

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As one of the world's biggest depositors of mine, China is undergoing rapid industrialization of mining. In this paper, the nature of industrial economy is illustrated based on the theory of recycle economy, and the new discipline of industrial ecology as an amalgam of concepts and techniques is introduced to provide the framework for stage-specific optimization of factors in mining. Conducted by the concept of industrial ecology, construction of recycle economy in typical mining area in Xuzhou city is investigated, and the constraints to mining industrial sustainability have also been analyzed. It shows that the Closed-loop chains and industrial symbiotic webs are the technological key and core of successful initiatives in the application of industrial ecology compared to the traditional technological support methods-cleaning production, waste reuse, pollution control etc.

Besides, a higher compatibility of dematerialization, Ecology recovery technology with the industrial system, as studied in industrial ecology, can result in lower resource extraction and reduced waste emission, contributing to a better industrial sustainability. In addition, an effective decision-making tool on material and process substitution is needed in the design process.

(ID 018) The Application of Phytoremediation Technology on Ecological Remediation in China Strip Mines

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Strip mines in China are mainly located in the three Northeastern provinces, Inner Mongolia Autonomy Zone and Guang Dong province. A great amount of strip materials will be produced during the mining exploitation with a general 5~10 cubic meter solid wastes per 1 ton. Those amount of spoiled wastes not only take huge land space, but also cause ecological environment devastation of mining area, represented by the reduction of soil PH value and obvious increasing of heavy metal content in soil. The paper has researched on phytoremediation technology based on Fushunxi Strip Mine in Liaoning province and Maoming oil shale strip mine in Guangdong province. Fushunxi Strip Mine has adopted phytoremediation technology by selecting spruce, Beijing peach and soapbark. After restoration, the basic physicochemical property of mining soil has turned better, the PH value increases from the range of 5.12 ~ 6.00 and becomes stable within the alkalinity range of 7.4 ~ 8.2, and the contents

of Pb, Cd, Cu and Zn decreased effectively. Maoming oil shale strip mine has adopted rich acacia, jarrah and pine to restore the soil. After the 18a restoration, the soil organic content increased 50% ~ 50.39% effectively, and soil PH value increased slowly from the range of 3.74 ~ 4.52 to the range of 4.45 ~ 5.51.

(ID 026) An Experiment Study on Influencing Factor on Permeability of Rock for Temperature

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By means of experiments, analyses the rule of rock permeability in temperature environment on triaxial stress condition, the sample's dimension is a cylinder of 200x400mm. During the experiment, it was observed that rock permeability appears five phases on the effect of temperature:

- low temperature phase (room temperature-100°C),
- forepart of threshold temperature (100°C - 250°C): rock permeability rise quickly,
- backpart of threshold temperature (250°C - 350°C): rock permeability decline,
- stabilization phase (350°C - 450°C): rock permeability is steady,
- high temperature phase (450°C - 600°C): rock permeability rise again.

On the triaxial stress condition, rock permeability is determined with the change of temperature.

(ID 035) Study on Green Logistics of Coal Enterprises Based on Circular Economy

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In this paper, we introduce green logistics based on circular economy to coal enterprises. First, we analyses the basic theories of circular economy and green logistics, and then dissertates about the relationship between circular economy and green logistics. On the basis of the analysis of the non-green factors of coal logistics system, we establish green logistics system of coal enterprises based on circular economy from all sides of the enterprises' logistics activities. Study we have done suggests that the core of circular economy is green logistics, and it is very important for coal enterprises to carry out green logistics management in the circular economy course, realizing the transformation from contaminative logistics to green logistics, saving and reusing resources, protecting environment, increasing economic benefit and promoting the sustainable development of coal industry.

(ID 019) Ecological Problems in China Coal Mining Area and Construction of Environmental Information System

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Our society developed along the route of traditional industrializing civilization, and accompanying with many coal mines being constructed, a great deal of ecological problems emerged, especially in coal mining area: its atmosphere, soil, water and geological condition were all destroyed more or less. All these directed in over-exploitation, ecological environmental pollution which affected the development of mines and human. This paper first expounded the content of environmental problems in coal mining area, and then investigated these problems as follows: during exploitation, plenty of mine tailings, CH₄ and collapse of ground were brought, soil and water resource became shortage and were greatly destroyed; during processing, a great deal of wastewater were discharged unorganized; many coal dust produced from transportation and a great deal of SO₂ and CO₂ from burning had an serious impact on atmosphere. Then some thoughts and methods to resolve environmental problems were suggested to realize the sustainable development of coal mining area, and finally, based on GIS, an environmental information system of coal mining area was constructed, which could support resources exploitation and environmental protection.

(ID 044) A Study on Cumulative Effects and Security Problems of Natural Resources and Environment in Mining Area

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The development of mine resources provides essential mineral raw materials for industrial and economic developments in China, but mining seriously damage the land, water, isotopic heterogeneous resources and environment in mining area. It has become one of the severe problems to protect the natural resources and ensure the environment security.

From the view of sustainable development, this research systemically investigates the producing mechanism, evolutionary laws, assessment methods and models of cumulative effects and security problems of natural resources and environment in mining area.

Firstly, the concept and perspective of natural resources and environment security in mining area are given; the models of natural resources and environment cumulative effects in exploitation and utilization in mining area are built; and the producing mechanism of security problem is discussed.

Second, the cumulative effects and security problem induced by the exploitation and utilization on the system of natural resources and environment in mining area are analyzed and assessed based on GIS. The effects on regional water and land resource security by the cumulative effects are studied.

Third, the restriction mechanism of agro-economic economic system evolvement caused by the natural resources and environment security in mining area are analyzed from aspect of integrative system; the cusp model of natural resources and environment evolvement in mining area is set up according to the catastrophe theory; the conditions of producing cusp are analyzed, and their basic control theory are given.

Forth, the model of synthetic evaluation of natural resource and environment security in mining area based on fuzzy logic inference is set up; and the sensitive factor analyzing method is discussed. Final, a case study is given.

(ID 060) Processes of the Modern Eolation as the Basis for Development of Methods of Mine Fields Recultivation

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Intensive perennial development of mining effecting results in a degradation of landscapes, contamination {pollution} of objects of the environment, having technogenic parentage. The most actual problems of mining effecting are recultivation of lands, regeneration of disturbed soil mantle and connatural ecosystems.

Regeneration of terrains which are earned additionally at coal mining, is carried out with the use of dump mine rocks. In this connection there is a problem of environmental safety of extraction areas under influence of the processes running with rocks on a diurnal surface.

Researches were carried out in terrain of the coal-mining enterprise in the Dnepropetrovsk region. An evaluation of an ecological state of soils carried out on a salt, microcomponental background on typical fields with various variants of recultivation.

The concept is proved and the mechanism of a modern eolation of dump mine rocks is offered. Two types of an eolation of rocks are picked out and indicators for each of them are offered. It is fixed, that processes are accompanied by leaching not only salts, but also trace substances. The complex procedure including laboratory modelling and natural observation which allows to estimate quality and quantitative composition of mobile forms of ingredients, leached from rocks is offered at various phylums of an eolation.

With application of the suggested procedure it is proved, that leaching is an integrated process and is accompanied by dissolution, exchange reactions, hydrolysis and sorption. It is proved, that the apostatis in composition and carrying out of heavy metals in environment is intimately linked to conditions of warehousing of waste products which determine phylum of an eolation. According to singled out attributes, dependence of an eolation on landscape conditions is fixed.

The ecological-geochemical model of migration of heavy metals on fields of recultivation and a means of an evaluation of their receipt into environment is offered. This model is put into a basis of a choice of procedure of performance of mine fields recultivation.

(EG/32) (ID 050) The Testing Analysis on Mechanical Properties of Marble Effected by the High Temperature

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The mechanical properties of marble are studied by the MTS810 Rock Mechanics servo-controlled testing system at the temperature up to 800°C to analyze the stress-strain curve, peak stress, peak strain, modulus of elasticity of marble. The results show that the peak stress and elastic modulus decreases with the increasing of the temperature in different degree, especially the rock mechanical strength would decrease suddenly in some certain period of temperature, while the peak strain increases step by step with the temperature. The ductility of the marble increased greatly at 800°C, meanwhile the strain increases slowly with the increasing temperature after the peak stress occurs.

Session 13. Environmental Geotechnology **Sekcija 13. Okoljska geotehnologija**

(ID 100) Environmentaly Geotechnology of Closure of Mercury Idria Mine

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The type and the quantity of closure activities and of rehabilitation measures are adapted to the circumstances and needs of present state of Mercury Mine Idria. The basic principles of preservation of life on the permanent basis, of protection of health of people and animals and of being friendly to the environment are taken into account.

The past five centuries of the Idria Mercury Mine's operations have had consequences on the environment, which have directly influenced the deformations developing in the wider exploration area. In order to guarantee safe and technically progressive ore mining, permanent pumping of mine water and the constant modernization of technology and other working fields, including ore processing and heating, increased ore production, the spread of mine works in to greater depths, and difficult rock conditions have in the past demanded the effective cooperation of different branches of technical and natural sciences. Mine shutdown works, which include grouting and hardening destroyed areas, as well as filling parts of the mine and backfilling empty spaces (i.e. mine roadways), are now in the final stage. The efficiency of mine shutdown works is constantly being verified by means of geotechnical and other measurements and observations, while considering the local rock conditions. The paper present problems of environmentally geotechnology of Idria Mercury Mine closure works.

(ID 046) Green Mining of Coal Resources Harmonizing with Environment

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To the serious environment problems of coal mining, a new concept of green mining is advanced. The connotation of green mining is to view and treat coal, coal-bed methane, ground water, rock waste and any other useful resources in abroad sense as "resources". Its basic startingpoint is based on the law of strata movement to prevent or to alleviate the adverse influence of coal mining on other resources and the environment as far as possible. The goal is to maximize the economic and social benefits. The technique frame of green mining includes water-preservation in mining areas, coal mining to retard surface subsidence, simultaneous extraction of coal and coal-bed methane, reducing of rock waste, underground coal gasification, etc.

(ID 094) Abandoned Metal Mining Impacts –Podljubelj Hg Mine Case Study

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In the surroundings of abandoned mining and smelting locations environmental problems such as elevated metal concentrations in soils/sediments, dispersion of toxic metals in soil and water and ecological damage are observed. Physical remobilisation of abandoned tailings, waste piles, channel beds and heavy metal-contaminated floodplains (formed during historic mining activity) provide large amounts of metal contaminants to rivers. Because mining necessarily involves disturbing of previously stable formations, and may involve exposing large quantities of material to weathering processes, the environmental effects of mining activities can continue long after operations have ceased.

To asses environmental impacts of past mining and roasting activities in Podljubelj, concentrations of total mercury in soils and stream sediments were determined in the surroundings of abandoned Hg mine. It was established that on an area of about 9 hectares Hg contents in soil exceed the Slovenian critical value for soil (10 mg/kg). Total mercury concentrations in soil

samples vary between 0,17 and 719 mg/kg, with the mean of 3,0 mg/kg. Mercury contents in stream sediments range from 0,065 to 1,4 mg/kg, with the mean of 0,64 mg/kg. The highest determined value in soils was found at the area around the former roasting furnace, where the ore was processed. Elevated contents of Hg were also found on the mine waste dump (108 mg/kg). Mercury contents in soils generally decrease with depth in soil profile and with the distance from the mine and roasting furnace. Mercury also appears in higher concentrations along the road that runs through the valley, which is due to the use of Hg bearing ore residues in road construction.

(ID 037) Application of Synthetic Mine Geophysical Prospecting Technique in Detecting Collapse Columns

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A synthetic mine geophysical prospecting technique for detecting the collapse columns is put forward. It is well known that the radio wave penetration can ascertain the relative position of abnormal structures (such as collapse columns, faults, and the thinning area of a coal seam) within coal seams, while the mine transient electromagnetism (TEM) method can be used to make clear the water-rich situation of an abnormal structure based on the variation of resistivity. The application of both the radio wave penetration method and the TEM method in detecting the abnormal structure in 7218 working face is introduced. At the same time, that the electrical characteristics of water-bearing structures can be obviously reflected by radio wave penetration is expounded theoretically. In addition, the application of synthetic curve analysis and tomography in data interpretation is researched. Finally, the hydro-geological features reflected by the V-shaped and the half V-shaped curves are

summarized.

(ID 038) Natural Stone Underground Mining in Slovenia- Stability Assessment Low With-to-Height Ratios Pillars

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In the world, underground mining of natural stone has been known for a long time. Natural stone was mined underground already by the ancient Romans. In Slovenia, underground mining of natural stone began to be introduced in 1993 at the Marmor Hotavlje Hotavlje I. coloured limestone quarry. Natural stone is still mined underground at this quarry today and since 2002 also at the Marmor Sežana Lipica II. limestone quarry. In both natural stone quarries, this mining method is dictated primarily by the condition of the quarries, along with an increasing demand for this raw material and the geological structure of the site. In the future, experience acquired in these two quarries will serve for introducing the method of underground mining also at other Slovene natural stone quarries which are suitable for the use of this mining method.

(ID 040) Energy Disturbance of Rock Wall and Energy Density Criterion of Estimating Rock Burst Under the Stress Wave

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The energy accumulation and its position are two main factors to be used to judge the rock burst occurring. Software ANSYS/LS-DYNA is applied to simulate the process of the energy accumulation and the effect of the depth of roadway to the energy accumulation, the character of the energy accumulation and its position is gained. The research results shows the stress wave

is an important factor to accumulate the energy in surrounding rock and induce the rockburst; And the depth of roadway H decides value of the maximal energy density (U_d)_{max} and the distance between its position and the surrounding roadway. The study results has an important significance to open out the mechanism of inducing rockburst and to forecast the rockburst.

(ID 068) Nuklear Environment Reconstruction on the Territory of Chernobyl APP According to Gamma-Spectral Analysis of Soil Samples and Literary Data

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Radiative conditions reconstruction at the place of radioactive accident according to research results of sample radionuclide composition was done by example of the Chernobyl atomic power-station failure happened in April 1986. The Chernobyl atomic power-station failure took place 20 years ago. A lot is comprehended and summed up. But the failure and its consequences are still an actual theme for studies.

Radiation exposure estimation on human, radiation protection, consequence forecast, somehow, are connected with radioactive features changes and dose calculation using physical and biophysical models. Here we face with common problem - impossibility to estimate reliability of results acquired without alternative way to check selected models. Radiochemical and spectrometric method for radionuclide determination in samples, taken at the places of radioactive accident, conducted some years ago after that, give an opportunity to calculate independently radiation fields and compare it with data, received during the accident. Such work is made at radiochemistry department chemistry faculty of MSU named after

M.V. Lomonosov.

19 years later the accident its possible to determine gamma-emitting radionuclide composition in sample of pulverescent sandstone taken in July 1986 on wayside of Pripyat –the Chernobyl AS road 1,5 km from 4-th power unit. It's interesting to determine relatively long-lived radionuclides such as Eu-154, Eu-155, Co-60, Am-241, which became possible, because majority of shot-lived radionuclides had decayed. Using reference and literary data radionuclide sample reconstruction was done on first and ten day after the accident. Possible variations of gamma radiation dose were determined for thin film model. Based on received data variations of absorbed gamma radiation dose were estimated, which is necessary for urgent decision making in the beginning of radiation accident. Received results are coordinated with published dose value data and validate a decision about people evacuation from the city Pripyat.

(ID 042) Numerical Analysis on the Rockburst in Coal Roadway of Deep Surrounding Rock under Stress-wave Disturbance

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Rockburst is a common dynamic disaster of mine in deep surrounding rock, which occurs with rock fracture and rock falling even rock casting phenomena in a short period during or after the roadway excavation. With the increasing of mining depth, rockburst becomes one of the most serious disasters which bothering the safety of the coal mine production. Nowadays the analyses of rockburst mostly focus on the mechanism and prediction also the prevention measures three aspects, all have achieved lots of progress. But fewer analyses pay attention to the whole process of rockburst which contains its occurrence and

development. Analysis on the whole response process of deep surrounding rock coal roadway under dynamic disturbance which are based on the surrounding rock initial stress environment and the dynamic disturbance intensity two related factors are constructed respectively by using the discrete element method software UDEC, moreover the transfer and dissipation rules of energy in the surrounding rock are concluded from the simulation. Those all would discover a more profound and visual image of rockburst.

Session 14. Environmental Geotechnology **Sekcija 14. Okoljska geotehnologija**

(EG/57) (ID 103) Zapolnjevanje odprtih jamskih prostorov rudnika urana Žirovski vrh s površine s polnilnim betonom

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Zaradi zapiranja rudnika urana Žirovski vrh je bilo opuščeno vzdrževanje jamskih prostorov. Opuščitev vzdrževanja ima za posledico popuščanje podpornih ukrepov, kar posledično vodi do širjenja rušnih procesov okoli odkopanih prostorov. S časom se zlasti v primeru nizkega nadkritja pojavijo deformacije površine nad odkopanimi prostori. V primeru rudnika urana Žirovski vrh bi preko razpok, ki se tvorijo v toku napredovanja rušnih procesov, prišlo do radiološke kontaminacije območja nad odkopanimi prostori blokov 1 in 2 rudnika urana Žirovski vrh. Kot ideja se je ponudilo izvajanje

zapolnjevanja izoliranih prostorov s polnilnim betonom, ki bi se ga v jamo zapolnjevalo preko vrtin izdelanih iz površine. Za zapolnjevanje odkopanih prostorov blokov 1 in 2 rudnika urana Žirovski vrh je bilo izdelanih 11 vrtin, skozi katere se je vgrajevalo polnilni beton v odprte jamske prostore.

(ID 103) Filling-Up Open Mine Spaces in the Uranium Mine Žirovski Vrh from the Surface with Filling Concrete

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Due to the closure of uranium mine Žirovski vrh maintenance of mining spaces have been abandoned. Abandoning of maintenance consequently brought to abatement of supporting measures which resulted in widening of the destruction processes around excavated areas. In the case of uranium mine Žirovski vrh radiological contamination of the area above excavated spaces of blocks 1 and 2 could appear through cracks. Idea about filling up isolated places with the filling concrete which could be poured into the mine through drills, made from the surface, has emerged. For filling up excavated spaces in blocks 1 and 2 of uranium mine Žirovski vrh 11 wells have been made for integrating filling concrete in open mine spaces.

(ID 107) Vrtalno minerska dela pri sanaciji kamnoloma brestanica za izdelavo kolektorja odpadnih vod

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Izkoriščanje mineralne surovine – gradbenega kamna ima pogosto za posledico trajno uničenje ali poškodovanje naravnega okolja.

Sanacija kamnolomov in površinskih kopov je vsaj delno vračanje v prvotno ali naravno stanje. Sanacija oziroma sanacijska dela za spremembo namembnosti opuščene kamnoloma Brestanica je pozitiven primer kako poškodovan okoliš spremeniti v koristnega in bolj naravnega. Glede na to, da je stalen problem odlaganje različnih odpadkov, se zapuščeni kamnolomi premalo koristijo v ta namen.

Sanacija, zaščita med izvajanjem minerskih del, zaščita pri izvajanju gradbenih del kot tudi zaščita za objekte, ki čistijo odpadne vode so sestavni del celote pri spremembi namembnosti opuščene kamnoloma. Zaradi objektov v bližini kamnoloma je potrebno pazljivo miniranje in kontrola vplivov miniranja s seizmičnimi meritvami.

Zaščita delovnega platoja, ceste in železniške proge se izvaja z izdelavo zaščitnega kanala, nasipa in lesene ograje ob sami železniški progi.

(ID 107) Drilling and Blasting Operations for Rehabilitation of Rock Quarry Brestanica for the Construction of Wastewater Collector

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Exploitation of raw mineral material like building rocks has a consequence of permanently destroying or damaging the natural environment.

Rehabilitation of rock quarries and surface mines means returning them to their original or natural state. Rehabilitation of abandoned quarry Brestanica is a positive example how to turn damaged environmental site into use and restore it to more natural state. Having in mind that disposal of various wastes represent permanent issue, the abandoned quarries are not sufficiently exploited for this purpose.

Preparations of abandoned quarry for useful purpose include rehabilitation, protection of surroundings during blasting, building operations and objects for wastewater purification. Since there are buildings in the vicinity of the quarry, it was crucial to carefully monitor blasting and its impact with seismic measurements.

The protection of working plateau, road and railroad was achieved with construction of protection channel, embankment and wood fence along the railroad tracks.

(ID 039) Coal Resources Cities Ecological Footprints in Shanxi Province from 1997 to 2005

- **Ruyin LONG**, *China University of Mining and Technology, School of Management, Xuzhou, Jiangsu, CHINA.*
- **Zhitao FENG**, *China University of Mining and Technology, School of Management, Xuzhou, Jiangsu, CHINA.*

According to the ecological footprint model, this text calculates the ecological footprints of Datong, Yangquan, Jincheng, Shuozhou cities and so on which are coal resources cities in Shanxi province, and has carried on the comparison and the analysis in that foundation. The findings indicated that, during 1997–2005 years, these four cities all are at the unsustainable development state, and the average per capita ecological footprints and average per capita GDP grow continually, ten thousand Yuan GDP ecological footprints present the drop tendency continuously. As a whole, the sustainable development states of

these four coal resources cities from 1997 to 2005 year are unoptimistic, and in that foundation the text proposes several methods of the sustainable development of these four cities in the future to choose.

(ID 036) Simulation Test Study on Compaction Character of Grouting Backfill in Caving Area

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Based on discrete element theory, the particle flow model of backfill body in caving area is built, and the relation of particle mesomechanical character, such as contact stiffness, contact character, and macrocosm character is analyzed. By particle flow numerical simulation, dynamic process of grouting backfill in caving area, including coal mining, roof collapse and backfill, are realized. The influence of filling ratio, cementation character and elasticity modulus of backfill material to the compaction character of grouting backfill in caving area is studied. It is found that filling ratio, if more than 15%, compaction curve of the model changes sharply, is the most sensitive factor influencing compaction character of backfill body; in the same filling ratio, yield point of cementation strength of backfill body, controlled by cementation strength of backfill material, is critical factor influencing the quantity of compaction subsidence, but not influencing the limit quantity; the smaller the backfill ratio is, the influence of elasticity modulus on compaction character of backfill body is more evident.

(ID 030) Study on the Design Method of Strip Grouting for Old Longwall Mining Goaf

- **Kazhong DENG**, *China University of Mining and Technology, College of Environment and Spatial Informatics, Xuzhou, Jiangsu, CHINA.*
- **Zhixiang TAN**, *China University of Mining and Technology, College of Environment and Spatial Informatics, Xuzhou, Jiangsu, CHINA.*
- **Jin HE**, *China University of Mining and Technology, College of Environment and Spatial Informatics, Xuzhou, Jiangsu, CHINA.*
- **Hongzhen ZHANG**, *China University of Mining and Technology, College of Environment and Spatial Informatics, Xuzhou, Jiangsu, CHINA.*

The residual movement and deformation of abandon goaf are the main factors causing the damage to building and structure over abandon goaf. Filling by grouting is the current main technology measurement to control the residual movement and deformation of abandon goaf. Based on analyzing the mechanism of the residual movement and deformation of abandon goaf, combined with the theory of mining subsidence, this paper presents the new method of strip grouting, gives the calculating formula of filling grouting borehole interval and the principle of grouting borehole setting. It provides viably and reliably technical method for economically and reasonably controlling movement and deformation of abandon goaf and ensures safety of buildings and structure on surface.

(ID 024) Experimental Study into Permeability of Broken Coal Gauge

- **Zhan-guo MA**, *China University of Mining and Technology, School of Sciences, Xuzhou, Jiangsu, CHINA.*
- **Xie-xing MIAO**, *China University of Mining and Technology, School of Sciences, Xuzhou, Jiangsu, CHINA.*
- **Fan ZHANG**, *China University of*

Mining and Technology, School of Sciences, Xuzhou, Jiangsu, CHINA.

- **Guang-li GUO**, *China University of Mining and Technology, School of Sciences, Xuzhou, Jiangsu, CHINA.*

Much attention should be paid to the permeability of broken rocks in goaf for the sake of water-preserving mining and disaster prevention. Using a special device together with the MTS815.02 Rock Mechanics Test System, we tested the permeability of Broken Coal Gangue during its compacting process, getting the relations between the axial stress and the differential seepage pressure and between the pressure gradient and the seepage velocity. The effect of axial stress, grain size, and seepage velocities on the permeability coefficient is analyzed. The result shows that 1) the permeability varies abruptly when the load reaches the compressive strength of rock samples, 2) for a constant seepage velocity, the differential seepage pressure and the axial stress can be expressed by an exponential function, and 3) for a constant axial stress, the pressure gradient and the seepage velocity can be also expressed by an exponential function, and 4) the permeability coefficient of Broken Coal Gangue with different sizes is closely related with its compaction state and will decrease with the increase of axial stress, having a logarithm functional relation between them.

(ID 023) Compaction Test on Coal Wastes Filled as Construction Material in the Sites With High Underground Water

- **Zhang SHAOLIANG**, *China University of Mining and Technology, Land Resource Management, Xuzhou, Jiangsu, CHINA.*
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The coal wastes have a characteristic that they will swell after absorbed the water so that the load bearing intensity will decrease, which is harmful to construction utility. The test aims to get the corresponding relations among the compaction height, carrying capacity, the soaking time, the depth of the underground water and so on. On the basis of the test, the paper presents some experimental formulas which can be used to estimate the loading capacity of the coal wastes in

the different conditions of underground water table.

(ID 049) Waste Substitution Extraction of Strip Extraction Coal-Pillar Under Buildings

- **Zhang JI-XIONG**, *China University of Mining and Technology, School of Mining and Safety Engineering, Xuzhou, Jiangsu, CHINA.*
- **Ju FENG**, *China University of Mining and Technology, School of Mining and Safety Engineering, Xuzhou, Jiangsu, CHINA.*
- **Cheng ZHONG-WEI**, *China University of Mining and Technology, School of Science, Xuzhou, Jiangsu, CHINA.*

In order to solve technical problems of mining strip extraction coal-pillar and disposing waste in underground, the waste substitution extraction was proposed. By expounding the effect to surface movement while the layout of waste filling roadway was centralized and decentralized and analyzing feasible coal-pillar's width of substitution extraction, the layout, which two waste filling roadway was placed in middle of strip extraction coal-pillar, was determined and its width and high was 4,0×5,0m, the coal-pillar width between filling roadway was 4,0m. Based on numerical simulation to analyze the stability of substitution extraction coal-pillar and vertical stress distribution of main roof in strip and substitution extraction, the conclusions, which the strength of substitution extraction coal-pillar achieved design requirement and strata structure of main roof was still stable, were reached. By the mechanics theory to analysis the character roof's moving and deformation after coal mining, the conclusion was got that the basic roof wasn't broken. The surface deformation wasn't over the allowing deformable of building. The research results have been successfully applied in coal mining.

D. ENVIRONMENTAL

GEOTECHNOLOGY/ OKOLJSKA **GEOTEHNOLOGIJA -** **ICWMEGGSD'07**

(EG/36) (ID 055) Bearing for Earthquake Isolation with Double Sliding Horizontal Surface

- **Federico BARTOLOZZI**, *Civil Engineer & Independent Researcher, Varese, ITALIA.*
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During an earthquake, the proposed bearing allows the foundation-soil complex to move in a any direction, sliding with respect a movable mass. In turn, this mass moves in opposite direction to the motion, sliding between two horizontal and parallel surfaces, with respect to both the movable foundation-soil complex and the overhanging building, which remains almost motionless. The displacement of the movable mass, which occurs on the basis to the the vector composition of the motion components X and Y, is due to movable devices present in opening provided in the building.

The earthquake isolation system, using this bearing, presents the following features:

- the seismic energy in the building amounts to around 1% of the building weight, using bearings with sliding friction (bearings with pure Teflon on sliding level double surface); this energy is negligible, using bearings with rolling friction (bearings with double steel ball on sliding level double surface);
- independence of the system from the seismic frequency, due to the total absence of building natural frequency;
- very financially competitiveness in comparison with all systems with total and partial absorption of seismic energy;
- substantial decrease in the psycho-physical discomfort in the inhabitants, due to the immobility of the building during an earthquake.

(EG/37) (ID 056) Suspension Aseismic Construction with Elastic Tie-

Rods

- **Federico BARTOLOZZI**, *Civil Engineer & Independent Researcher, Varese, ITALIA.*
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The aseismic system, concerning the proposed suspension construction, has the following characteristics:

- absence of direct contact of the construction with the soil (suspension construction);
- transfer of the load to the soil by means of elastic steel tie-rods.

The inertial force in the construction due to an earthquake undulatory shock is directly proportional to the construction displacement variation and inversely proportional to the length of the tie-rods. It has a zero value when the first parameter has zero value or when the second parameter has infinity value. The displacement variation is never equal to zero if the soil displacement and the construction displacement are in phase; vice versa it is equal to zero in phase opposition only with reference to the design seismic frequency equal to $\varphi_p = 1.41 \varphi_{0,n}$ where $\varphi_{0,n}$ is the construction horizontal natural frequency. The design seismic frequency is selected only on the basis of statistical data concerning the design area. In order to safeguard the construction against the resonance danger, which occurs when the seismic frequency equalizes the construction natural frequency, it is necessary to determine an interval of - undulatory and sub-undulatory - seismic frequencies, where the frequencies, including the resonance one, are not compatible with the construction safety.

Therefore, with respect to this emergency interval it is essential that suitable devices – that is horizontal dampers and vertical frequency converters – spontaneously start in order to decrease the construction displacements to values not greater than prearranged admissible displacements of design. In addition, the numerical analysis points out that the inertial force in the suspension construction with tie-rods is on average 4% of the corresponding inertial force in the same construction without tie-rods.

This considerable decrease of earthquake energy in the construction gives to the proposed system a remarkable economical competitiveness with respect to other existing aseismic systems.

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GLAVNE DEJAVNOSTI

GEOTEHNOLOGIJA

- Računalniško modeliranje podzemnih objektov
- Geotehnične analize
- Laboratorijske in "in-situ" preiskave hribin

RUDARSTVO

- Raziskave in razvoj metod za odpiranje ter izkoriščanje nahajališč mineralnih surovin
- Preizkušanje in razvoj rudarske opreme
- Zdravje in varnost v rudarstvu

TEHNOLOGIJE ZA OKOLJE

- Sanacija rudarskih škod zaradi posedanja površine
- Čiščenje odpadnih voda in drugih odpadkov v rudarstvu in predelavi mineralnih surovin
- Ponovna uporaba in recikliranje odpadkov
- Sanacija starih odlagališč rudniške jalovine
- Podzemno odlaganje odpadkov

ZEMELJSKI IN VODNI VIRI

- Izračun in ocena izkoristljivosti rezerv zemeljskih naravnih virov
- Vrednotenje in zaščita vodnih virov
- Modeliranje podzemnih vod
- Laboratorijske in "in-situ" preiskave

VARSTVO OKOLJA

- Ocena vplivov na okolje in izdelava celovitih poročil o vplivih na okolje
- Zaščita vodnih virov
- Določitev stopnje ogroženosti okolja zaradi hrupa in miniranja
- Raziskave s področja ravnanja z odpadki
- Izdelava študij onesnaženosti, ranljivosti in zaščite podzemnih vodnih virov

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GLAVNE DEJAVNOSTI

GEOTEHNOLOGIJA

- Projektiranje predorov in drugih podzemnih objektov
- Ukrepi za stabilizacijo zemeljskih plazov in podpiranje kamninskih mas
- Laboratorijske preiskave geomehanskih karakteristik materialov
- Analize stabilnosti objektov in izdelava ekspertnih mnenj
- Specializirane geotehnične meritve v predorogradnji in pri drugih podzemnih delih
- Računalniško modeliranje podzemnih objektov
- Geotehnične analize

RUDARSTVO

- Projektiranje površinskih kopov in podzemnih rudnikov

TEHNOLOGIJE ZA OKOLJE

- Svetovanje in izdelava konceptov integralnega reševanja problematike ravnanja z odpadki
- Načrtovanje površinskih in podzemnih odlagališč odpadkov
- Sanacija obstoječih odlagališč odpadkov
- Načrtovanje ločenega zbiranja, sortiranja in kompostiranja odpadkov
- Načrtovanje in izvedba predpisanih monitoringov
- Ocena vplivov na okolje in izdelava celovitih poročil o vplivih na okolje
- Izdelava študij onesnaženosti, ranljivosti in zaščite podzemnih vodnih virov

ZEMELJSKI IN VODNI VIRI

- Projektiranje vodnjakov, odvodnjevanja in vodooskrbe
- Vrednotenje in zaščita vodnih virov
- Modeliranje podzemnih vod

Oglas RIKO



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- Projektiranje, svetovanje in nadzor na področju gradbeništva, geotehnologije, geologije, ravnanja z odpadki in rudarstva
- Revidiranje in recenziranje rudarskih projektov

GLAVNA PODROČJA DELOVANJA

- Tehnologija za okolje
- Geotehnologija
- Rudarstvo
- Gradbeništvo

TEHNOLOGIJA ZA OKOLJE

- Svetovanje in izdelava celostnih konceptov reševanja problematike ravnanja z odpadki
- Izdelava projektne, tehnične in investicijske dokumentacije na področju ravnanja z odpadki
- Načrtovanje površinskih in podzemnih odlagališč odpadkov
- Sanacija, rekonstrukcija in zapiranje ter prilagoditev obstoječih odlagališč predpisanim zahtevam
- Načrtovanje ločenega zbiranja odpadkov, zbirnih centrov, zbiralnic ločenih frakcij in sortirnic
- Načrtovanje objektov in naprav za biološko in mehansko obdelavo odpadkov pred odlaganjem

GEOTEHNOLOGIJA IN GRADBENIŠTVO

- Ukrepi za stabilizacijo zemeljskih plazov in projektiranje podpiranja kamninskih mas
- Analize stabilnosti objektov in izdelava ekspertnih mnenj
- Računalniško modeliranje – 2D numerične analize
- Geotehnične analize
- Sodelovanje pri projektiranju predorov in drugih podzemnih objektov
- Projektiranje zaščit gradbenih jam
- Izdelava geološko geomehanskih poročil o zgradbi tal ter pogojih temeljenja objektov

RUDARSTVO

- Projektiranje površinskih kopov in podzemnih rudnikov
- Izdelava projektne, tehnične in investicijske dokumentacije na področju rudarstva
- Izdelava in projektiranje podzemnih prostorov na področju inženirskih gradenj, predorov
- Izračun in ocena izkoristljivosti rezerv in zemeljskih naravnih virov

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