



VARIREI07: SIV-ISAP
Workshop Recycling/Re-Use
Asphalt, 28 June, L'Aquila



University of L'Aquila - School of Engineering, June 28, 2007

International Workshop

Asphalt Recycling and Materials Re-use in Asphalt Pavements

Identification of open questions and research needs



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General Overview

- In recent years the problem of recycling and disposal of wastes has become increasingly urgent for both economic and environmental reasons.
- remedy a situation of environmental degradation caused by the creation of tips, meet the growing demand for aggregates from a constantly declining number of quarries
- Reserves of natural quarried materials are also diminishing, partly due to urban legislation that increasingly favours environmental conservation.



**Need for
Recycling and Re-use of Materials**



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General Overview

The International Society of Asphalt Pavement (ISAP), ISAP WG05, and the Italian Society of Road Infrastructures (SIIV) organized the: **International Workshop Asphalt Recycling and Materials Re-use in Asphalt Pavements** – Identification of open question and research needs to discuss about the following subjects:

- Interest of Society, Interest of User and Owner, Interest of Designer and Contractor;
- Performance: mechanical properties, durability, chemical and structural stability;
- Environmental and sustainability issues: benefits and drawbacks;
- Construction issues, material design, cold or hot techniques.



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Main Subjects

Recycling:

Re-Use of **pavement materials** in Placements

Goal:

- **No down-cycling**, i.e. use of 100% in same function with same or improved properties and performance as new materials
- Repeated recycling possible

Re-Use of Materials:

Re-Use of materials from **non-pavement origin** in pavements

Goal:

- **No linear landfill**, i.e. use of 100% to obtain equal or improved properties and performance as with new material
- Repeated recycling possible



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General Overview

ISAP TC WG5 „Re-Use of Construction Materials for Asphalt Pavements“

Task: Explore different aspects of the re-use of construction materials for asphalt pavements, such as:

- Environmentally **sustainable** material (when, where does re-used material make sense?)
- **Repeated recycling** and material **resources**
- **Durability and aging** of pavements with re-used pavement material
- **Compaction** and **quality** issues (life cycle analysis)
- **Pavement design** aspects for re-used materials
- **Mix design** link with **RILEM**: RAP content, binder, additives, moisture, mixing process
- **Low energy asphalt** mix production and placing/compaction
- **Emissions** and **working safety**
- In situ **performance**

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General Overview

ISAP TC WG5 General Recycling Research Topics

- **Temperature:** hot, warm, cold (emulsions, foam bitumen, etc)
- **Mix design:** mix components, mix properties, combination w. concrete
- **Placing:** Installation: compaction, homogeneity, mixing techniques, energy reduction, health aspects, noise
- **Layers:** wearing, binder, base coarse, overlays
- **Sustainability:** repeated recycling, material components (stones additives, stimulation to use RAP)
- **Durability:** moisture/water, mechanical resistance, aging, performance under combined effects
- **Test and assessment methods:** binder, mix, aggregates, environment

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Società Italiana di Infrastrutture Viarie

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Program

Time	Event	Task	Notes	Where?
08:30	Welcome, Organization	Planning, House- Keeping		Main Room
09:00	Presentations 1..6 (15' each)	Introduction & back-ground to subjects & questions	Co-Chairs Montepara/Partl	
10:30	Coffee Break			
11:00	Mini-Presentation 1...15 (4' each)	Prepared input to the questions of Workshop	Co-Chairs Montepara/Partl	2 Class Rooms
12:30	Lunch Break			
14:00	Parallel Sessions WG 1 (Montepara, Santagata) + WG 2 (Partl)	Identify open questions & research needs	Secretaries & Projector/Laptop	
15:30	Coffee Break			Main Room
16:15	Presentation Synthesis of Group 1 and 2 (20' each) & Discussion (20' each)		Co-Chairs Montepara, Santagata/ Partl	
17:35	Adjourn & Final Comments			
17:45	End of Workshop			

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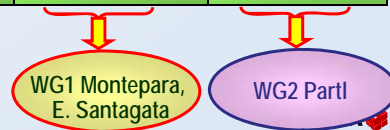
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Organization of Topics

Interest of	Subjects	Re-use of Materials in Asphalt Pavem.	Recycling of Asphalt Pavem.
Society	Environmental & Sustainability Issues • benefits • drawbacks	Presentation 1 Gordon Airey	Presentation 2 Martin Hugener
User & Owner	Performance • Mechanical Properties • Durability • Chemical and Structural Stability	Presentation 3 Dariusz Sybilski	Presentation 4 Virginie Mouillet
Designer & Contractor	Construction Issues Material Design Cold or Hot Techniques	Presentation 5 Ezio Santagata	Presentation 6 Hussein Al-Khalid



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Mini-Presentations/Statements

- Hussain BAHIA (presented by Gabriele TEBALDI)
- Doug CARLSON (presented by Ines ANTUNES)
- Antonio BIANCO
- Francesco CANESTRARI
- Carlo CRISTINI
- Sandro COLAGRANDE
- Elena ROMEO
- Antonio D'ANDREA
- Marco GAROFALO
- Manfred N. PARTL
- Ettore MUSACCHI
- Marco PASETTO (presented by Nicola BALDO)

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Main-Presentations - 1

*Gordon AIREY
Nottingham Transportation Engineering Centre - University of Nottingham -
United Kingdom*

**Re-use of Materials in Asphalt Pavements. Interest of Society.
Environmental and Sustainability Issues: Benefits and Drawbacks**

- The presentation introduces a future strategy based on integrating material flows: waste management, network level, generating asphalt planning, linked to recycling needs. **Life cycle Analysis** is introduced as a tool to evaluate the environmental impacts associated with stages of a product's lifecycle from cradle to grave.
- Some **examples** of re-use and recycling materials are presented. **Crumb rubber tires, industrial slags, waste products** (glass cullet and plastics), bio-materials are listed for re-use process showing mechanical properties.
- **RAP** is mentioned for recycling in hot and cold techniques.

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Main-Presentations - 2

Martin HUGENER

Road Engineering / Sealing Components - EMPA Dübendorf

Recycling of asphalt Environmental and sustainability issues

- **Describes all possible problems arising during recycling:**
production of dangerous emissions during recycling steps: dust, leaching, fume emission that are temperature dependent;
- recycling of tar-containing asphalt is a ticklish question, for the presence in tar of a large amounts of toxic PAH.
- **An example on Switzerland pavement layers contain between 0 and 100% tar is exhibited.**
- At the end there are some open questions to resolve problems as “**How to avoid the “contamination” of asphalt with new harmful compounds?**”.



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Main-Presentations - 3

Virginie MOUILLET

LCPC / LRPC of Aix-en-Provence (France)

Recycling of asphalt pavements : interest of user and owner

- The presentation proposes the topic of recycling and the main reasons for it, like: optimization of use of natural resources (natural aggregates), limitation of waste depositions (less dumping of material) and preservation of the environment by the reduction of the exploitation of new quarries.
- Taking into account the major steps involved in the recycling process of RAP, it is underlined that there are some problems arising in using RAP clearly more complex than in using virgin natural aggregates and new binders.
- A key problem is the potential use of RAP in new asphalt mixes in consideration of chemical compatibility of new binders with old bitumen in RAP and physical performance of the resulting binder.
- **How often a Reclaimed Asphalt can be reused in new asphalt pavements?**



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Main-Presentations - 4

Dariusz SYBILSKI

Warsaw, Poland

Need for road pavements recycling = Need for research

- The presentation describes the **variability of recycling for cement concrete pavements, with a short exposition of phenomenon of rubblizing**, for new asphalt pavement and for new cement concrete pavement, its various options
- Performance-based (related) properties are listed (stiffness, fatigue characteristics, permanent deformation resistance, water resistance, cracking resistance) showing the **opportunity for Long Life pavement design**.
- Research should implement the same performance-based test methods and requirements for new and recycled materials. At the end, the question is: **"Are there any limitations for recycling?"**.



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Main-Presentations - 5

Ezio SANTAGATA

Politecnico di Torino

Cold recycling of bituminous mixtures

This presentation gives a general overview on the topic of recycling,

- interest/problems of society, users, road owners, designers and contractors and giving some examples about specific solutions or problems.
- Advantages and disadvantages, problems in mix design and in testing and modeling are underlined.
- Critical issues derived from research experience are presented, like the characterization of the emulsion-filler system. At the end there are some closure question concerning improvement in production plant, the separation of RAP in fraction to control gradation, stiffness, mix design, performance and in field tests.



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Main-Presentations - 6

Hussein AL-KHALID
University of Liverpool, U.K.

Asphalt recycling and materials: reuse in asphalt pavements

- Outline of current recycling position in UK, where it is common, encouraged and is specified by national standards.
- Description of experiences with re-use of two materials in asphalt pavement: **tyre rubber and incinerator bottom ash aggregate** with possible challenges and problems.
- The challenges involved in rubber asphalt are outlined as no cross-linking between rubber and bitumen, storage problems, long-term performance, etc...
- An example of re-use of incinerator bottom ash aggregate in asphalt is illustrated showing some parameters like moisture sensitivity.
- Future challenges proposed concern viability of IBAA mixtures and durability.

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Mini-Presentations

Hussain BAHIA (presented by Gabriele TEBALDI)
Department of Civil and Environmental Engineering - The University of Wisconsin - Madison

Promotion of re-use and recycling in asphalt road construction

- The presentation explains **how to promote re-use and recycling** and lists some rules for it;
- it describes the role of international forums and organizations.

Top points of research:

- the research of the best methods for recovery and processing of waste;
- how many cycles of recycling can a material go through before it becomes un-usable;
- a development of a prediction models of salvage value of virgin materials;
- a development of a risk assessment tool for estimating risk to short and long term performance.

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Mini-Presentations

Doug CARLSON (presented by Ines ANTUNES)

Asphalt Rubber Italia

When the rubber meets the road

- The main topic is the **Asphalt rubber technology** and its advantages correlated.
- Environmental benefits are also pointed out (More than 30000000 tires were recycled since 1988, AZ). Construction-phases of a asphalt rubber pavement are also described.

Antonio BIANCO

ABICert

Certificazione dei Prodotti da Costruzione

- This presentation provides some information about **CE conformity marking for Asphalt concrete for roads and other trafficked areas**.
- It is also illustrates the Italian "norme tecniche per le costruzioni, NTC, DM. 14-9-2005".



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Mini-Presentations

Francesco CANESTRARI

Università Politecnica delle Marche - Ancona

Asphalt Rubber: Research & Development in Italy

- Asphalt Rubber and Rubberized Asphalt Concrete (definition & benefits)
- Example of experimental evaluation is illustrated.
- Further actions for research are mentioned (pilot projects).

Carlo CRISTINI

Settore "M-E" Provincia di Chieti

Considerazioni sull'impiego di materie prime secondarie nella costruzione di OO. PP.

- The presentation provides a general **overview about Italian standards**, laws and regulations concerning waste materials and their possible use also considering performances.
- The case history of "Provincia di Chieti" about re-use and recycling is illustrated.



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Mini-Presentations

Sandro COLAGRANDE

University of L'Aquila

Influence of compaction and maturation time on cold-recycled asphalt pavements with Foamed bitumen and cement

- **Foamed bitumen** recycling process
- Influence of the **compaction degree** on the mechanical properties of the mixtures and the influence of the maturation time on the mechanical performances.

Elena ROMEO

University of Parma

Performance-related specifications for rap mixtures. Characterization and quality control of by-products

- Considerations about how RAP influences mixes and their mechanical and performance properties
- The need of defining "performance-based" specifications, compaction and construction specifications and of a quality control protocol.



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Mini-Presentations

Antonio D'ANDREA

University of Rome "Sapienza" - Engineering faculty

Re-use of materials in asphalt pavement

- Sapienza University' activity about recovering of waste materials and the national project they carried out about recycling materials for asphalt pavements.
- The results are positive, important and useful but now the research suffer a setback: permissions, authorizations. The solution maybe can be the independence of research activity, but is it possible?

Marco GAROFALO

Wirtgen Macchine s.r.l.

Need for developing practical design guidelines for cold recycling

- Brief explanation of Wirtgen machines and the their operating principles
- Two possible solutions of cold recycling are outlined: foamed bitumen and bitumen emulsion.



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Mini-Presentations

Manfred N. PARTL

Adj. Prof. Carleton, Ottawa, CA - EMPA, Swiss Federal Laboratories for
Materials Testing and Research, Center Road Engineering/Sealing
Components - Dübendorf, www.empa.ch/Abt113

Some Swiss Recycling Aspects

- The principles of Swiss recycling are listed;
- A diagram of the planned project in Switzerland is also proposed.

RILEM & ISAP Activities on Recycling

- RILEM TC 206 ATB. The task is to evaluate tests & mix design for use of RAP for hot mix recycling and to propose recommendation; (aging protocols)
- ISAP TC. The task is to explore different aspects of recycling, such as **repeated recycling**, durability and **aging**, pavement design, emissions, etc.
- Research topics are identified: temperature, mix design, placing, layers, sustainability, durability, test and assessment methods



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Mini-Presentations

Ettore MUSACCHI

ETRA, European Tyre Recycling Association

EcoLanes - "Economical and sustainable pavement infrastructure for surface transport"

- Flexible and rigid pavements - tyre-fibres to improve performances. Then introduces EcoLanes background, organization, projects.
- Finally benefits for tyre recyclers and for construction industry are listed.

Marco PASETTO (presented by Nicola BALDO)

Università di Padova

Re-use of bottom ash in road construction: environmental and mechanical critical points

- Re-use of municipal solid waste incinerator bottom ash in asphalt concretes for base layers and in cement bound mixtures for road foundations.
- Mechanical and physical suitability were investigated.
- **Question: "how is it possible to obtain an accelerated stabilization of the bottom ash?"**.



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Questions for WG's (1 & 2)

Identification of open questions and research needs

- 1) What should be the major future **R&D directions** (what is promising, what is not?) what should be the priorities?
- 2) How to deal with **quality, durability, functionality** (where special and where not)?
- 3) How promote re-use & recycling in terms of **social & political acceptance**?
- 4) What could/should be the role of **international forums & organizations** and how could we proceed to achieve to that role?

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Questions for WG's (1 & 2)

Identification of open questions and research needs

- 5) What is the role of **academia-practice**, i.e. university, research institutes, companies,... in terms of implementation of research;
 - what are the responsibilities of each partner and
 - how can you make sure that all work together as team and
 - that nothing gets ignored?
- 6) How and in what cases seek **alliances** with whom?
- 7) How get **funding** (government and private), i.e. who should take the risks & benefits...patents?

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Work Group 1 Re-use: Results

Moderators: Antonio MONTEPARA, Ezio SANTAGATA

**Asphalt recycling and material re-use in asphalt pavements-
identification of open questions and research needs**

- The direction of R&D is life cycle analysis and to consolidate performance testing and that the asphalt rubber is a promising application.
- Concerning quality, durability, functionality, integrations from material science, attentions to dangerous materials, updating technical specification, database and performance-base tests are necessary.
- In order to promote re-use we should educate new generations and we should obtain technical and scientific support, also from Administrations.
- More importance to working groups and technical committees.
- Money for the research
- Alliances with social parties and administrations
- Scientific cooperation



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Work Group 2 Recycling: Results

Moderator: Manfred N. PARTL

**Asphalt recycling and material re-use in asphalt pavements-
identification of open questions and research needs**

- The major future R&D directions should be:
 - the accelerated curing
 - functional and performance tests for prediction
 - the use of cold asphalt to reduce emission,
 - the classification and the best use and treatment of RAP.
- Respect to quality, durability, functionality the increase of RAP's quality, and the development of a reasonable separation method to obtain fractions and RAP to perform separate analysis are necessary.
- To promote re-use and recycling the criteria of contracting in term of **life cycle analysis should change**; owners have to invest in monitoring **long-term pavement performance**
- Universities and Research Institutes should help society to adopt this point of view.



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ISAP2008 Symposium

Topics

- Emissions and working **safety**
- **Noise** reducing pavements
- Drainage and **water** susceptibility
- **Low energy** asphalt mix production & placing
- Environmentally sustainable **new materials**
- Repeated recycling and material resources
- **Durability** and aging
- Innovative **design**
- Roads for **energy production**
- Roads for envir. friendly **winter maintenance**



Aug. 18th...20th, 2008

www.empa.ch/ISAP2008

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