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Executive summary

Sustainable Waste Management of additives in products: A global challenge

Report on the 4th workshop of the RISKCYCLE Coordination Action

New Delhi, India 11th - 15th Oct. 2011

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1 Introduction

The fourth RISKCYCLE workshop was organised under the topic “Sustainable Waste Management of additives in products: A global challenge” and held from 11th - 15th October 2011 in New Delhi, India. The host of the workshop have been Col. Rakesh Johri and Dr. Suneel Pandey from The Energy and Resources Institute, New Delhi, who had prepared a workshop programme with very interesting presentation topics related to the key issues of the project. This workshop has again been a very useful and successful platform for all project partners to exchange information with involved local and international scientists, policy-makers and stakeholders. The following group pictures shows the majority of involved project partners and participants.



Group picture of all participants taken during the workshop in New Delhi

The workshop was divided into two days of interesting presentations and discussion. Within six sessions of challenging content, the more than 40 participants could listen to 17 presentations related to the key issues of RISKCYCLE.

Environmental problems related to unknown behaviour of additives in recycling processes, intensifying efforts to minimize emissions during recycling processes by assessing and evaluating their risks in different steps of waste management and recycling activities have been part of the workshop agenda.

2 Summary of the 1st conference day – 12 October 2011

2.1 Summary of session 1

The first session of the fourth RISKCYCLE workshop was dedicated to welcome all participants to The Energy and Resources Institute (TERI) in New Delhi and to introduce the goal and scope of the project. The workshop hosts Col. Rakesh Johri and Dr. Suneel Pandey from TERI used the chance to welcome all participants and hoped for interesting presentations and successful discussions.

In his opening speech the host of the workshop **Col. Rakesh Johri** introduced the importance of the RISKCYCLE workshop for India. He outlined the past activities concerning political acts and new strategies, which need to be implemented as soon as possible. As an example E-Waste was mentioned, which is not treated properly in India. The necessity is clearly visible and high, but the users and populations awareness is very low. The amounts of E-Waste in India and around the world are growing exponentially, and every new electrical item may lead to new problems for health and environment, if it is not treated properly. Non-scientific processes to treat E-Waste, like using acid bath, are very dangerous for people handling with it. Therefore Col. Rakesh Johri outlined again the need to discuss these current and future issues with scientists and politicians and to solve them as soon as possible, or if not possible to lower the danger.

The second speech of the first session was given by **Anil Kumar** from TERI and he used the speech to share his views with the audience on this occasion, especially about waste, which is not treated properly. A disaster management is necessary and a new disaster management act in India is already in discussion between government and the community: the main conclusion of it is that prevention of waste is better than every technology. Mr. Kumar shared the opinion to move this idea forward, for example to focus on the treatment of hazardous subjects, which is very important, and also to introduce mega school projects (first safety in schools) to increase the safety awareness. Until now there is no proper awareness of properly treatment for hazardous materials and chemicals. These actions may lead to a challenge for implementing a framework on national and state level for environmental management that integrates chemicals. Further on food safety standards need to be improved, since the food chain also includes a lot of chemicals.

Mr. Kumar outlined that the knowledge and network of TERI invites the guests to work together on chemicals and chemical safety and also to clarify what is the duty of the people and the authorities. Environmental risks need to be reduced, since they can't be brought to zero, everybody has to deal with it. Transferring them to the producers again will motivate them to reduce risks in the beginning, before they occur in the environment.

In the third speech the coordinator of the EU project RISKCYCLE, **Prof. Bernd Bilitewski** from Technische Universität Dresden, introduced the goal and scope of the project to all workshop attendees and highlighted the necessity of a successful workshop and the importance of a global network of information about the risk of chemicals and additives in products. Further on he introduced the philosophy of a coordinated action, the difference to a research project and the objectives of the project.

Recycling material is a very important good and most of the materials have a second or third life or even more and will be transferred into a new recycling plastic. In recycling materials enclosed hazardous additives need to be monitored and analysed, especially micro pollutants. Packaging waste might be old, but since it might have been stored in households, additives of past production periods might still go into the current recycling chain and the danger will still be present in the future. Recycling plastics which go back into our new products might still include old additives and cause harmful effects to the environment.

As a conclusion to his speech Prof. Bilitewski highlighted also the necessity of new measurement methods for chemical testing and that it is necessary to centralize and unify the testing methods to avoid useless additional testing, when testing has already been done.

2.2 Summary of session 2

The first presentation of session 2 was held by **Kevin Munn** from United Nations Environment Programme (UNEP). He introduced the main issues and needs of the "Chemicals in Products Project" (CiP) and why the project has been set up. The growing awareness of potential adverse effects of chemicals found in common products has led to increasing pressure for information on chemicals in products.

As a first step a prioritisation has been done to define the project scope: electronics, children articles, clothing, building products, cosmetics/personal care and food

containers/packaging. The common drivers for a “chemicals in products” information system are the need to meet legislative requirements, concerns among consumers and public interest groups regarding safety of products, industries concern for product liability and corporate image, corporate policies regarding safety and health and environmental performance. Manufacturers, end-producers and brand owners can affect change by insisting that chemical information is provided to them.

At the end of his presentation Mr. Munn highlighted the potential benefits of a CiP system, which would create greater efficiency and reduce costs, improve preparedness to respond to regulatory restrictions regarding individual chemicals, provide a firm basis for informed choices and contribute to more sustainable use of resources through improved information about quality of materials aimed at recycling.

The second presentation of this session was given by **Rakesh Hooda** from TERI, proposing a Master Plan for disposal of used mercury based lamps in India, which might become a functional framework for management. His aim is to establish a new legal framework, since a functional framework for management of safe & effective end-of-life FLs does not exist in India at the moment.

Mr. Hooda highlighted the key issues, like what should be the efficient collection and transport mechanism - given the decentralized pattern of usage, what may be the most efficient, cost effective and scientifically proven disposal technology and how to ensure a self sustaining business model for the recovery and recycling processes. Further on he introduced the study object, which is about developing a master plan for the safe management of end-of-life mercury bearing lamps. It needs to encompass detailed analysis of the baseline status of usage, recovery and disposal of used FLs and will be using secondary and primary survey data, international practices and management options for India and an institutional framework. At the end of his presentation Mr. Hooda explained how this master plan could be implemented, for example by starting a comprehensive public awareness campaign to sensitize the range of actors and stakeholders.

In his speech **Prof. Damià Barceló** from the Spanish National Research Council (CSIC) introduced the topic of fate and global risk of nanomaterials in the environment and recycling wastes to the audience. He outlined that although the knowledge about nanomaterial is still very low, the interest of industries about this

topic is growing. The amounts of nanomaterials have increased globally, for example due to combustion processes, which in the last 200 years have already released high amounts of nanoparticles to the environment and today the rising importance of nanotechnology causes new input. New nanoparticles might be more persistent, since they can be stabilized by capping or fixing agents such as surfactants or organic matter. In his conclusion he mentioned that nanotechnology can open a new window to environmental friendly industrial processes and new remediation technologies. Since there is still a lack of information about occurrence, fate and behaviour of nanomaterials in the environment, it is highly required to establish safety and hazard factors, new waste and recycling management schemes and to define specific regulatory control for nanomaterials.

In the last presentation of the second session **Shyamala Mani** from University of California in Berkeley introduced the issues of using brominated flame retardants (BFR) in products, especially in electronic products. They are normally additives and not chemically bound to the plastics or textiles. BFRs are added to and hence may leach into the environment, for example during the recycling process. Some may be reactive, but may not polymerize fully and also leach out. Being lipophilic, many persist in the environment and bio-accumulate. Further on she showed where BFRs may assimilate, for example have they been found in human tissue and wildlife. She also highlighted that uptaken PBDEs can lead to autism and other birth defects, like harming the childrens brain development.

2.3 Summary of session 3

The third session of the day was opened by **Mahendra Patil** from National Environmental Engineering Research Institute in Nagpur. He presented a first risk based remediation approach used in India on a mercury contaminated site. The site has been a production site for mercury thermometers from 1984 on and after detecting the Hg contamination it was closed in 2001. As a source of contamination expelled mercury vapours from work place to surrounding area have been detected and require the development of a remediation strategy. A possible risk assessment methodology could include steps like: issue identification, hazard assessment, exposure assessment and risk characterization.

The third presentation of this session was given by **Chandra Babu** from Central Leather Research Institute, Chennai. He introduced the leather industry in India, the

main operation steps within leather production itself (chemical consumption) and its history, for example that the leather industry is considered the second oldest in the world. Although that the leather industry still has a very negative image within the population, due to the factoring and release of residues and remains. The main focus of chemical management in leather production is set on the choice of chemicals for pollution reduction, eco-design, leather processing, reuse/recycling options for some chemicals, compliance to Eco-bans and compliance to REACH regulations. Tanneries are forced to comply with stringent norms for liquid waste, secured disposal for solid waste and currently the Government is planning to force the tanneries to go for processing of salt-free hides and skins (Salt-free preservation methods).

The third presentation within this session was given by **Stefan Rydin** from NORDECONSULT Sweden AB under the topic “Chemical Management in the Leather Industry – A case study from Europe”. According to him the leather industry is a very chemical demanding production industry: today each kg of leather produced, demands 3kg chemicals input. Approximately 350 different chemicals are used today, 50 up to 1000 chemicals are tested each year to see if some can be changed and 25 up to 30 new chemicals are introduced per year. When talking about the reduction of chemicals the reduction of nitrogen-containing chemicals, phosphorous and organic solvents, nonylphenol ethoxylate and acrylamide are the most important tasks. Chemicals have different ways to be released into the environment, although best available techniques are introduced. Despite best efforts there will always be some chemicals released. As prediction for the future Stefan Rydin introduced his opinion about what are the future drivers for chemical management – it will be the customer requirements, legislation and barriers.

2.4 Summary of session 4

The fourth session of the first workshop day was divided into two presentations. The first speaker was **Meena Sehgal** from The Energy and Resources Institute in New Delhi about the topic “Heavy metal uptake in vegetation grown in Yamuna river bank- Delhi segment”. In the beginning Ms. Meena introduced the objectives of the presentation, which was to estimate the concentration of heavy metals (nickel, lead, cadmium, cobalt, arsenic, mercury) in the irrigation water,

drinking water, soil of Yamuna river and select vegetables grown in this segment and to compare the values with an unexposed area.

Further on levels of heavy metals in women (100) and their children (100) from communities involved in agricultural activities have been measured and compared.

Comparisons with USEPA water quality criteria 2005 for surface water show that Ni, Cu, Pb, Zn, Mn exceed limit at most sites and for Hg at one location. Average values of metals in soil show that Ni, Cu, Pb, Cr, and Hg levels are higher than Dutch reference values. The Assessment of mercury levels, in vegetables grown near chlor-alkali plant at Ganjam, India showed significant levels in the leafy vegetables namely, cabbage and amaranthus, which were reported to be significantly higher than the levels at control site.

The second presentation in this session was given by **Jenny Westerdahl** from IVL in Sweden and her presentation was titled "Mapping emissions from use and waste management processes with substance flow analysis". She started her presentations informing the audience about the system of substance flow analyses (SFA) and highlighted it by introducing one example of pathways of hazardous substances. Further on she presented a case study on diisononylphthalate (DINP), which is mainly used as plasticiser in PVC (95%). Next to emissions during industrial processing, important factors for estimating emissions, like amount use and trade statistics, chemical registers have been introduced and explained.

Possible pathways during the use phase are diffusion, wear and tear and cleaning/washing. The used impact factors when estimating emissions from the use phase are accumulated amount, the surface area, use patterns and chemical characteristics for each substance. Further on she introduced problems related to waste management, one of them was recycling of PVC flooring. The majority of DINP incorporated in products remain when the products enter waste management systems.

During these recycling steps fragmentation of PVC increases the surface area and leads to increased emissions, which can be estimated using the same methodology as for use. Further problems related to waste management may occur due to incineration, landfill processes and wastewater treatment. As a final outlook she concluded by saying that emissions and fate modelling are important tools to generate data and validate calculations and that SFA is a useful method to give a holistic image of chemical flows.

2.5 Final discussion of Day 1

During a final discussion at the end of day 1 it was outlined how important the information from industries are. Unfortunately these information are limited, like it was shown e.g. within the presentation from Kevin Munn (UNEP). Therefore one of the basic discussions should be “what is in or what is not in products”. For the project RISKCYCLE it would be very important to know what is in the products, which is one of the important challenges which need to be solved in the future.

In India the involved partners are still struggling with basic problems and try to link and solve these basic problems. Micropollutants are still not part of the legal agenda in India. It is therefore necessary that they also get access to “product fingerprinting”, to do a similar research like it is done in Europe and to do coherent investigations.

Another important point is the informal sector, which is very widespread in INDIA, no matter which materials are considered. It will always be necessary e.g. to look at the use of mercury, like it was shown in the presentation of Meena Sehgal.

Interesting presentations about modelling and the use of those models, have shown that it is nearly impossible to use them in Indian circumstances, without updating them with local values and information.

The understanding of global problems and obvious issues related to waste, need to be developed. As recommendations for future research – the presented studies have shown that studies need to be in a global scale, not only on local scale. It is necessary to look more detailed on risks to humans and environment. Handling waste in (informal) recycling processes in some places of the world need to be improved to minimize risks, e.g. the uptake via skin during treatment without protection.

One of the main aim of RISKCYCLE is to develop recommendations about future research needs. The presentations of all RISKCYCLE workshops have already been interesting examples, e.g. the ones related to informal e-waste recycling activities.

In India exist numerous not authorized recycling activity sectors. For RISKCYCLE it is now important to get access to these activities data. Correct data is very important, especially from people working in the informal sectors in Asian countries. Their main important issues and demands are the future research needs.

3 Summary of the 2nd conference day – 13 October 2011

3.1 Summary of session 1

The first session of the second workshop day consisted of four presentations on different topics related to “Fate and environmental risk assessment and Impacts to human health”.

The session was opened by **Prof. Rosa Mari Darbra** with her speech titled “Risk assessment of chemical additives, ending up in waste water treatment plants”. She informed in her presentation about environmental risk evaluation of chemical additives, ending up in waste water treatment plants in Catalonia using two different methods COMMPS methodology and fuzzy logic model. She introduced the basic information about the two models, like procedure and basic parameters. The results showed that both models take into account the exposure and the effects of the substances found in the samples, but human and environmental toxicity are evaluated in a different way. The results presented by both models are in good agreement, but the fuzzy logic model is more conservative than COMMPS. Both models are user-friendly and give an understandable result for decision-making processes. However, fuzzy logic takes into account the uncertainty and variability associated to the environmental parameters, making the model more trustable.

The second presentation of this session, titled “South of China e-waste recycling processes - Health Risk assessment of Lead released by using 2FUN Tool”, was given by **Nicoletta Siucu**. In her presentation she introduced her investigation using the 2-FUN tool to assess the risks of e-waste recycling processes in one region in the south of China. The town of Guiyu is the largest e-waste site in the world and the second most polluted spot. Since 1995, e-waste from US & elsewhere have been continuously transported to Guiyu & “recycled” by villagers. The informal recycling operations are: separation, processing and recycling of plastics and manual separation of products.

Further on she explained the methodology and the input data which were used. The results didn't show a real health risk for humans due to lead released during the e-waste recycling operations. Gaps in the input data have a high influence on the results obtained and more exposure pathways should be considerate for more realistic results. The global sensitivity analysis effectively discovered which input parameters and exposure pathways were the key drivers of Lead concentrations in the arterial blood of adults and children.

The third presentation of this session titled “Development of a multi compartmental pharmacokinetic model for human health Risk Assessment. Application for PFOS and PFOA” was given by **Prof. Marta Schumacher**. She introduced the topic by stating that human health risk assessment permits to evaluate the safe pollutant concentrations, but classically health risk assessment considers only the exposure dose, without considering the body fate of the chemical. Therefore e.g. the assessment and monitoring of PFOS and PFOA becomes more and more important. Physiologically Based Pharmacokinetic models (PBPK) permit to predict the concentration of a chemical in a tissue along the time.

For the validation information from Tarragona/Spain have been used, including a lot of monitoring results which showed that two main sources of PFCs exposure are the food intake and water. The results obtained have been compared with plasma results measured in Tarragona area and showed only a diversion of 4% in PFOA.

Prof. Ettore Capri gave the last presentation of this session, titled “Dioxins, who’s at risk? Children and Infant Exposure to PCDD/Fs”. In the beginning of his presentation he made clear that the most important exposure is the work exposure. The attention to children as the most exposed population members seems to be the most logical decision. The most important information about cancer and no-cancer effects of exposure to dioxins have been carried out in studies after accidental exposures in Missouri and Asia.

At the end of his presentation he concluded that the presence of persistent bioaccumulative contaminants in breast milk is not a reason for limiting or termination of breastfeeding. Breast milk contains many substances which have positive impact on the developing of immune, hormonal and nervous system of newborns and are needed for protection of their body against illness. It is necessary to diminish and when possible eliminate certain pollutants from environment in order to diminished infants, children exposure. Certain effects on human body can be monitored and predicted using PBPK models, which saves time and money. Therefor PBPK model is seen as a suitable tool for chemical risk assessment.

3.2 Summary of session 2

The second session of this workshop days was held under the topic “Environmental impacts of use and recycling of additives in products: a lifecycle perspective”. The first presentation of session 2 was given by **Lauran van Oers** and it was titled “LCA case study Cushion Vinyl Floor covering and DEHP”. The main aim of the presentation was to present the results of a study about cushion vinyl floor covering, which was carried out at CML in the Netherlands.

He outlined that Life cycle assessment (LCA) and Risk assessment (RA) are complementary. Within RA actual impacts of a toxic substance are included, considering local conditions of processes and environment. LCA includes potential impacts of toxic additives (DEHP) in larger context: e.g. total of environmental problems or the total chain of processes.

Concerning waste management the process data had to be estimated, since for waste treatment no detailed data are available. Additionally it has been modeled with general characteristics.

The second presentation of this session (“LCA case studies - Textile and printed matter”) was given by **Henrik F. Larsen** from DTU. The key element of his presentation has been the question “What is LCA”, including characteristics, elements; goal and scope, inventory and LCIA. It was followed by the introduction of an LCA impact profile on printed matter and an LCA impact profile on textile (T-shirt). Further on he gave also examples on potential “additives” in recycled paper and textiles: hazardous substances, which have been found in the Danish printing industry and in textiles on the Danish market.

The last presentation of this session, by **V. P. Singh**, was titled “Application of plastics in health care and acquaintance with toxicological applications”. In the beginning he introduces plastics in general, the types, parameter, properties and production processes. These information were followed by information about additives, like plasticizers, stabilizers, colorants and flame retardants. The presentation ended with remarks concerning non-sustainable waste treatment and adverse health implications.

3.3 Final discussion of Day 2

At the end of the second workshop day, the information and outcomes of all presentations have been summed up and discussed during a panel discussion. The panel consisted of the workshop hosts Rakesh Johri, Suneel Pandey, Prof. Bernd Bilitewski and Prof. Damià Barceló. The panel members first summarised from their individual point of view the impressions of the workshop.

Within the presentations about fate and risks of use of different materials, the project members showed clearly how difficult it is to get the right information about recycling, use phase, production line of products and to evaluate the risk occurring in these steps. The introduced paper and textile industries are good examples for the use of LCA, but showed also the influence of missing information resp. data gaps on the expected results of the investigations. Concerning future research need and gaps in the field of LCA, it would be necessary to add a number of chemicals to the assessment, to avoid only to look at the products themselves.

The presented LCA case study on paper is also important for the question: Paper or plastic? There are still classic questions for policy makers about how policy should be changed – there is still the need of support from the government to improve the current situation.

In some countries the government pressurises the researchers not to do too much research concerning environmental topics, to avoid getting the public too much aware of the problems. The presented basic approaches of the workshop are seen as possible basis for a sustainable living.

It was also highlighted that after already the 4th RISKCYCLE workshop all partners of the project learned a lot from all the useful presentations and interesting discussions. According to the panel these information are more useful than only reading publications, without getting in contact with the author. The main messages are that the RISKCYCLE workshops are considered as very useful and successful. It addresses quite important topics, and the research gaps raise huge challenges, with scientific aspects and also political and economic aspects, which may complicate the identification of solutions.

The panel thanked Col. Rakesh Johri and Dr. Suneel Pandey and their team for arranging a very successful workshop.

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