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Executive summary

Environmental and health risks of chemical additives and recycling materials

Report on the 3rd workshop of the RISKCYCLE Coordination Action

Rio de Janeiro, Brazil, 2nd – 6th Mai 2011

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1 Introduction

The third RISKCYCLE workshop, which took place in Rio de Janeiro, Brazil, between 2nd and 6th May 2010, was held under the main topic “Environmental and health risks of chemical additives and recycling materials”. The hosts of the conference have been two Universities of Rio de Janeiro - UFRJ and UFRRJ – under the direction of Prof. Adriana Soares de Schueler (UFRRJ), Prof. Dr. Claudio (UFRJ) and Prof. Dr. Bernd Bilitewski (TUD). It was the 3rd of 4 international workshops of the EU FP7 funded project RISKCYCLE.

The workshop provided the project partners with the possibility to get in contact not only with the involved scientists from the project partners, but also to discuss current issues and current findings with local scientists, politicians and representatives of associations from Brazil. The assembly of participants from different organizations can be seen in the group picture below.



Group picture of all participants taken during the workshop in Rio de Janeiro

The global trade of chemicals and products containing chemical additives has resulted in a substantial release of harmful substances to the environment with risk to man and nature on a worldwide scale. With regard to life cycle thinking it is important that products undergo a recycling step after their use phase. Unpredictable and not foreseen health and safety problems may result, if the composition and the behavior of components and additives in recovered materials are unknown. The project is focusing on consequences due to the behavior of chemicals and additives and their release during recycling of six chosen fractions.

2 Summary of the first conference day - 3rd May 2011

2.1 Summary of session 1

The first conference day on 3rd May 2012 was opened by Prof. Bernd Bilitewski - the coordinator of the project RISKCYCLE. In his presentation he outlined the importance of the project, not only for the participating partners, but also for all countries worldwide.

He introduced the concept of Circular Economy, which is transforming the traditional patterns of economic growth and production. The global trade of products and chemicals, such as paper and cardboard, cosmetics, plastic toys, textiles and electronic appliances, may lead to not foreseeable problems during the recycling phase of these products and may also result in substantial releases of harmful substances to the environment with risk to man and nature due to unknown behaviour of these included additives.

Within the last 20 years there have been several common efforts to harmonize the safety assessment of chemicals and products in a worldwide trade, with different results and outcomes, but there is still a lot of work to do.

The second presentation of session 1 was given by the workshop host Prof. Claudio Mahler under the topic “20 years of a slow evolution of solid waste management in Brazil”. The main idea of the presentation was to show an introduction to the slow development of waste management systems in Brazil, especially in the federal state of Rio de Janeiro. Waste management can be extremely complex, as in the case of hospital and production waste, which can be a seriously dangerous.

Numerous issues in the past and today have caused by non-existing or poor standard waste management. Uncontrolled production brought numerous benefits to the quality of human life, but brought also various problems. People enjoy the benefits of modern life without thinking beyond their behaviour. They simply ignore or pretend not to know the dangers and harmful effects of producing waste.

Even today`s landfills, which were built in the past, only consist of inadequate technology on unsuitable sites with no protection for soil, groundwater and air. For the future the waste management systems and the behaviour of the population should improve drastically, to avoid dangerous threads to humans and nature.

2.2 Summary of session 2

The second session of the day was opened by Júlio Carlos Afonso from Federal University of Rio de Janeiro. The topic of his speech was “Additives in WEEE: A Challenge for Recycling”.

In his presentation he pointed out that within the last 60 years flame retardants have been used in circuit boards to prevent or retard the spread of fires. They are incorporated by chemical reactions or simple addition. Brominated flame retardants (BFRs) are very useful in products. Since the increasing demand for personal computers and electrical equipment, the amounts of BFRs in WEEE has been risen. The majority of WEEE is currently exported to Asian countries to regain the contained valuable elements, like for example Copper. Unfortunately the recycling methods in these countries (manual treatment, open incineration etc.) are very low tech and cause diseases due to inadequate handling. These procedures created an increasingly large environmental problem in these countries. There are already many techniques for removal of flame retardants from WEEE, for example solvent-based recycling technology, which is the most commercial viable and environmentally beneficial treatment option for removal of PBFRs.

The second presentation of session 2 was given by Marcelo Guimarães Araujo from Rio de Janeiro. The topic of his presentation was “WEEE in Brazil - local impacts of pervasive products”. The environmental impact of WEEE is of growing concern due to the presence of hazardous substances. The presentation presented the flow of mobile phone equipment in Brazil and focused on the manufacture of parts and components, use and end of life treatment of mobile phones, selected to show the overall life cycle dispersion of the impacts of EEE in general.

In his speech he also gave an overview of the mobile market in Brazil, of hazardous substances contained in mobile phones and the flow of devices, components and substances.

Due to the rapidly expanding global market for mobile devices, their disposal is a big concern in every country. Consequently, their waste needs special attention from all stakeholders to in order to establish sound and fair policy measures for the end of life of these devices.

2.3 Summary of session 3

The session was opened with the presentation “Coproprocessing - sustainable destination for municipal solid waste” by Francisco José Piffer Leme. He pointed out that industrial ecology already aims at trying to reproduce the life cycles of the inherent nature. In doing this, the industry may be less damaging to the environment. He explained his opinion about coprocessing as technical disposal and permanent destruction of waste, reusing the potential energy and raw material of waste, without generating environmental liabilities. Waste should be inserted in this process to avoid obstructing composition of the clinker and emissions. He introduced the technology of mechanical-biological treatment (MBT) to treat the waste and produce a dry-stabilate which can be utilized in coprocessing.

The second presentation of this session was given by Antonio Lacerda de Menezes and he tried to answer the question “Where are we now?” and gave an overview about the current state of the art of coprocessing in Brazil. The advantages of coprocessing are heat recovery, reduction of waste volume and additional revenue from waste in comparison to usual landfilling. Potentially hazardous industrial waste, like for example paint and oil sludge, resins, polymers and wastewater sludge, usually needs a good and safe destination. Due to the rising demand for cement, coprocessing would be a logical technology to treat waste and use its energy content. A cement plant requires investment to guarantee quality, safety and environmental protection. These plants already have intense operation controls, (raw materials quality, fuels, and quality of the waste), emission control systems and monitoring of heavy metals and persistent organic compounds.

In his next presentation Walter Suemitsu gave an overview about the separation of waste experience at Universidade Federal do Rio de Janeiro (UFRJ). In 2007 the Technology Centre of UFRJ started a project to implement waste selective collection programs with the objective to dispose the waste, generated in the campus, in an environmentally friendly and correct way. The separation of recyclable materials and their destination to associations and cooperatives of recyclable materials collectors have been established. Important parts of the project have been Training seminars about selective collection and recycling, creation of a website, banners and informative folders, to raise the awareness of the University Community. As a result the quantity of waste collected and the revenue of the cooperative increased.

The fourth presentation in this session, named “The challenge of chemical contamination in plastics recycling”, was presented by Vladimir Kudrjawzew. He introduced the history of plastics, becoming more and more important in our society. In the beginning the population’s awareness about producing huge amounts of plastic waste and its arising dangers was very low. Nowadays in an increasing number of areas around the world, the communities started to be aware of it and to separate, treat and recycle plastic waste. In doing so they have to be aware of numerous different types of plastics, like PET, PEAD, PEBD, PP, PVC, PS and many more. The production of products with different purposes requires numerous additives, which are added to the original plastic within the production process. Recycling them without the knowledge of their behaviour in the recycling process is a very important and big challenge for the society nowadays.

2.4 Summary of session 4

The fourth session of the day was opened with the presentation named “Reutilization of Residues in High Aggregated Value Products – Biorefinery Concept” by Marisa Fernandes Mendes. Fossil fuel reserves are running out and global warming is becoming a more and more dangerous threat. The biorefinery concept; which is based on renewable resources and feedstock will become an alternative to the 100% oil based production of fuel.

Organic municipal waste and organic production waste, such as byproducts of the vegetable oil refining process or byproducts of the oil extraction process, will become more important when it comes to producing alternative fuels or energy production (heat, electricity). The main objective of this investigation was the study of potentialities of different residues and/or byproducts. She answered the question what could be a good raw material by introducing soybeans and Jatropha, explained properties and advantages of these plants and finally explained the possible concept of biorefinery. In conclusion it was said that the use of biomass as raw material for bioenergy and biochemical production contributes to revitalize rural areas and the use of sustainable feedstock is not enough to ensure a prosperous future for later generation, the protection of our environment using green methodologies is also required.

The second presentation of this session by Zilton José Sá da Fonseca was about the Healthcare Wastes Management in Rio de Janeiro City and how it could be

improved to avoid dangerous threats to the people. The classical healthcare waste can be divided for example into the fractions pharmaceutical waste, infectious waste, chemical waste and non-clinical waste. Dangerous threats occur because of irregular waste disposal of 73,3% of the original waste fraction, which means that only 26,7% are disposed in a sanitary landfill. Segregation of healthcare waste and subsequent recycling steps would improve the situation.

The last presentation of this session was given by Damià Barcelo and is titled: “Environmental and health risks of perfluorinated compounds at global scale: From the kitchen to Antarctica”. PFCs are thermally stable, chemically inert and non-flammable and therefore chosen as additive in several products, such as carpets, upholstery, paper, textiles, cookware, paint, polymers and lubricants.

The objectives of the investigation were the development and validation of different analytical methods based on liquid chromatography coupled to tandem mass spectrometry (SPE- LC-MS/MS) for the analysis of PFCs in the environment, food and also human samples. The case studies included online, as well as offline approaches. The occurrence of PFCs has been analysed in tap-water, in food samples, like fish, meat or dairy products, in human samples, like breast milk, cord blood and hair and also in Biota samples and soils from remote areas as the Antarctica.

As conclusions it was said that the main sources of PFCs in diet are through environmental contamination and their accumulation and biomagnification in food webs, therefore fish is an important contribution of PFCs in human diet. Another important contribution is through drinking water contamination and certain cooking processes or packaging materials. Contamination of the aquatic environment, food webs and atmospheric contamination are contributing to the global spread of these compounds which presence have been proven in remote areas such as the Antarctica. In the future the study of human accumulation of PFCs, especially in sensitive populations as childrens and the presence of PFCs in food will be investigated further.

3 Summary of the second conference day – 4th May 2011

3.1 Summary of session 1

This session was devoted to different aspects related to risk assessment. In first place, there was a presentation from the manager of planning and industrial control of Petrobras, Mr. Ricardo Baptista. Petrobras is a Brazilian company leader of distribution of fuels and lubricants in this country. It is the biggest company in Brazil and the 8th biggest in the world concerning market value and it is present in 29 countries.

The speech for this session of Mr. Baptista was about the situation of the collection and recycling of oils and lubricants in Brazil. He introduced the production scheme of lubricants as well as their uses. There is a clear increase in the consumption of this product. The growth of the number of motorcycles in Brazil is one of the causes for this raise. The objective of Petrobras is to close the cycle of the lubricants through the recollection and recycling of these chemicals. There are 42 collectors installed all over the country and 19 re-refining places to recycle the used lubricants. With these installations, Petrobras is recycling more than required by the legislation.

The second presentation of this session was done by Prof. Antoni Ginebreda from the Spanish Research Council. His speech was about the prioritization of chemicals in the environment. Chemicals are used over the world in important amounts. Analytical chemistry has evolved a lot and it is able to detect these compounds at trace levels. Therefore, Prof. Ginebreda highlighted the importance of prioritizing within all the chemicals that can be found in environmental samples. The environmental and human risk assessment of these substances can be a good tool to prioritize. An example of one methodology with this purpose was presented, COMMPS. This method was developed by Fraunhofer-Institut in 1999 and it stands for combined monitoring-based and modelling-based priority setting. This method calculates an exposure index that combines with an effect index to get a prioritization index of the substances. The pros and cons of the analytical measurements versus the modeling systems were also discussed.

The last presentation of this session was done by Rosa Mari Darbra from the Polytechnic University of Catalonia. This speech focused on the risk assessment of

Brominated Flame Retardants (BFR) using a new method called fuzzy logic. BFRs are used in plastics, electronic devices, textiles and others to prevent fire. Due to their capacity of bioaccumulation, persistence and biomagnification, they can be found in the environment. Therefore, a model to assess their risk was presented and applied to a scenario located in the Ebro River (North of Spain). The fuzzy logic methodology was presented as well as the main results obtained after its application to the study area. This methodology seems to be user-friendly and provides outputs that can be understood very easily for the human brain, facilitating the decision-making process. The future work includes using the same methodology with other Persistent Organic Pollutants (POPs) and assessing their risk for the environment.

After the presentations, there was a discussion on the recollection system used by Petrobras to recover the lubricants as well as on the recycling system. Questions on the fuzzy model presented by Rosa Mari Darbra were also made.

3.2 Summary of session 2

This session consisted of 2 presentations on different topics related to life cycle assessment. Two speakers from the RISKCYCLE project participated in this session. A third speaker from RISKCYCLE, Prof Ester von der Voet, declined due to illness shortly before the session started. Her presentation is therefore included here.

The first speaker was Dr. Tomas Rydberg from IVL. His presentation was about “Additives and Life Cycle Assessment – introduction and overview”. He started up by giving an overview of life cycle assessment (LCA) including some of the challenges when LCA is used in waste management. Afterwards he presented the principles of substance flow analysis (SFA) and its relation to LCA. The last part of his presentation was dealing with elements and principles on how to assess additives in LCA. This part included examples on e.g. additive emissions from tire and plastics in Sweden, and an overview of different life cycle impact assessment methodologies. Furthermore, different approaches on LCA valuation (weighting) including monetization was also presented. He concluded that in combination with SFA, LCA is in principle useful regarding global management of additives in waste.

The second speaker should have been associate professor Ester van der Voet from CML. The title of her presentation is “Additives in plastics: (lack of) information from LCA databases and case studies”. The first part deals with the principles of LCA focusing on the functional unit and the added value of including LCA (and not only risk assessment) in waste management. The presentation continues by defining the three layers, i.e. chemicals, materials and products, being part of the LCA approach in RISKCYCLE. How to deal with the RISKCYCLE case study on plastics is then presented and followed by results from a screening of available plastic inventory data in 33 databases. Also results from a review of 110 plastic LCA case studies are shown. The presentation is finished by showing three main research needs regarding LCA on additives in plastics and paper: procurement of additive emission data, procurement of additive production data, and calculation/estimation of additive characterization factors for life cycle impact assessment.

The actual second speaker was Henrik Fred Larsen from the Technical University of Denmark. His presentation was about life cycle assessment (LCA) of printed matter and included a preliminary analysis of potential additives in recycled paper. As the first part of his presentation he presented the general principles of life cycle assessment (LCA) using the case study on printed matter as an illustrative example. In the last part he showed results from a substitution project on mapping and ranking chemicals used in the Danish printing industry. Almost 30 of the chemicals found meet one or more of the criteria for “substances of very high concern” (SVHC, according to REACH), being e.g. carcinogenic and/or reprotoxic. Several of these substances, like certain phthalates and certain pigments, are components in printing inks and may therefore follow (and in varying degrees stay in) the paper when recycled.

As part of the debate following the presentations, issues like the pros and cons regarding recycling of paper and plastic as compared to incineration and/or landfill (dumping) was raised by the audience and discussed. Also the importance of economic incitements and the significance of enforcing environmental laws were discussed.

3.3 Summary of session 3

The session started with an overview of Research exchange programs between Brazil and Germany, with an outlook to other EU countries, and EU itself. The presentation was given by Veit Grundmann from Technische Universität Dresden. He introduced past and current projects between German and Brazilian partners, for example the project “Pollutants into the residual waste and landfill sites due to electrical and electronic equipment (WEEEBRAL)” or “Integration of the Informal Recycling Sector in Solid Waste Management in Brazil “

There are several opportunities for students, junior and senior researchers to benefit from exchange programs. In particular, Germany and Brazil have a long tradition of bi-lateral agreements for research collaboration, in particular researcher mobility. Veit Grundmann held an inspiring presentation, and it was evident from the discussion following the presentation, also in the coffee breaks and later on during the workshop, that there was a big interest to explore opportunities further, both from Brazil to Europe, and from Europe to Brazil.

As second presentation, Prof. Susanne Heise gave an overview of the situation regarding e-waste around the world and its content of selected additives.

E-waste is one of the 6 material flows in focus in RISKCYCLE. Prof Heise’s presentation highlighted the global flows of e-waste and related risks health and the environment. In particular she showed initial results from ongoing work on Substance flow analysis (SFA) for the content of lead and brominated flame retardants, more specifically PBDE, in e-waste. SFA is a very powerful tool in that it helps keeping track of the occurrence of specific substances, but it also has challenges, one of the more evident ones relating to finding reliable data.

This presentation was followed by Nicoleta Alina Suci, who presented a case study assessing health effects from Lead exposure in an area of intense e-waste recycling. A very large share of the global e-waste flow is shipped to Goyju in China, where recycling takes place. The operations are undertaken in processes of varying quality, so the human exposure of hazardous substances can potentially be significant. Nicoleta Suci showed fresh results from a still ongoing assessment of the exposure level in this geographic area, elaborated using the 2-FUN model. Until now, the results are promising, but some unexpected discrepancies were also

described between modelled results and monitoring analyses of lead in human blood in the area. It was discussed that these discrepancies could potentially be attributed to that only two main exposure pathways have been included in the model so far.

A planned presentation by Prof Francesco Casanova relating to the use of secondary material in production of non-ceramic brick was not held as he unfortunately had to cancel his participation.

3.4 Summary of the final session

In his speech, Prof. Claudio Mahler, elaborated around the current situation of waste management in Brazil, in which he highlighted the energy and resources that could potentially be saved, if recycling would be fully explored, as well as its potential savings in greenhouse gases. The work in the presentation was a joint work of Prof. Mahler and Luciano Basto Oliveira, EPE.

The presentation formed an excellent introduction to the following plenary discussion, about the content and the expected outcomes of this RISKCYCLE workshop, with the prospects of future waste management in Brazil as its starting point, with a discussion around social, societal and spatial aspects of waste, and pollution of chemicals from these flows. The panel consisted of Professor Adriana Soares de Schueler, Professor Claudio Mahler, Walter Issamu Suemitsu, Professor Damia Barcelo, and Professor Bernd Bilitewski.

All of the attendants used the chance to summarize the content and discussions of the last two workshop days. When it came to the summary of the workshop, everybody agreed that the main topics of RISKCYCLE are important all over the world. The different types of products and recycling technologies differ, depending on the region. What they all have in common is the need to focus on improvements and monitoring activities. Using the example of Brazil it was made clear that it takes far too long until politics made a decision concerning the legislation of waste management and treatment. Still the majority of Brazils waste is landfilled, without proper treatment, suitable sites and without monitoring the landfills.

The workshop was formally closed by Walter Suemitsu, as representative of the Federal University of Rio de Janeiro. The panel thanked Professor Mahler and his team for arranging a very successful RISKCYCLE workshop in Rio de Janeiro.

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