

# Introduction

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**Abstract** Chemicals are part of different daily products due to the characteristics that they provide to them. However, their release into the environment during the end of the product's life can affect harmfully the environment and the citizens. The worldwide transport of these chemicals at a global scale increases this negative potential effect. In this sense, initiatives such as the RISKCYCLE project (risk-based management of chemicals and products in a circular economy at a global scale) are trying to assess the risks of these substances in a circular economy.

This second volume of the book presents the results obtained during the RISKCYCLE project, paying special attention to a set of selected additives in the diverse industrial sectors (i.e., PFOS, DEHP, Pb). Different methodologies have been used to analyze aspects such as the fate, human and environmental exposure, and toxicity of these compounds. Case studies have been developed to assess their risk in developing countries such as China or Vietnam. The findings have been presented in the different RISKCYCLE workshops as well as at the final conference in Dresden.

Finally, some research gaps have been identified which will provide the framework for future work in the field of the chemicals and the environment.

**Keywords** Chemical risk, Environment, Global scale, Human health

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This book includes the results of a Coordination Action funded by the European Union called RISKCYCLE (risk-based management of chemicals and products in a circular economy at a global scale). This project (n. 226552) started the 1st of September of 2009 and ended on the 31st of August 2012. Its main objective was to establish and coordinate a global network of European and international experts and stakeholders from worldwide countries (e.g., European countries, China, India, Brazil, Vietnam) to assess the risks of hazardous chemicals and additives contained in different daily products.

In order to accomplish with the aforementioned aim, during the first year of project, an extensive research on the different chemical additives used in six industrial sectors was conducted: plastics, textiles, electronics, lubricants, leather, and paper. A list of selected chemical additives was identified for each sector and used as a study basis for the rest of the project. This is the case of the decabromodiphenyl ether (BDE) used in electronics as a flame retardant or the triclosan used in the textile as a biocide. The results of this investigation were presented in the first volume of this book (Global Risk-Based Management of Chemical Additives I: Production, Usage and Environmental Occurrence). This volume also included a section of case studies related to the selected additives in different countries (i.e., Denmark, Vietnam, Brazil, India). The main outcomes of the first part of the project are summarized below:

- There exists a very wide range of chemical compounds used as additives in final products.
- The role of the chemical additives in order to provide the final characteristics of the products is essential.
- These additives can be applied during different stages during the product production (e.g., manufacture, finishing process).
- At the end of the product's life, the chemicals can be released into the environment with potential harmful effects to humans and ecosystems.
- Information regarding emission, fate, exposure, and toxicity of these chemicals is scarce, especially at the end of the product's life.
- Assessing the environmental risks associated with additives along the whole product's life cycle at a global scale is an issue of paramount relevance, which requires the development of proper methodologies and effort to gather information.

This last outcome was the starting point for the work to be done during the second part of the project. At this point, the different work packages focused on their topics, that is, in environmental fate, toxicology, risk assessment, life cycle assessment, and socioeconomic issues. The objective was to apply the different methodologies related to these fields of knowledge to the selected substances in order to assess the potential risk that they can pose to the human health and the environment.

In part I of this second volume, a review of these different methodologies has been conducted. The potential benefits of the different models as well as the drawbacks are analyzed in order to select the most suitable of them for the

application to particular case studies. In addition, also in this part, some aspects related to the chemicals regulations are also reviewed, especially those affecting the European new chemicals legislation, such as REACH (regulation concerning the Registration, Evaluation, Authorizations and Restriction of Chemicals). Some socioeconomic aspects are also treated in relation to the need of chemicals for the society.

On the other hand, in part II of this volume, a set of case studies are introduced. The application of the selected methodologies inside each one of the foresaid disciplines (e.g., risk assessment, life cycle assessment) to specific cases and countries is presented here. The results of such application are discussed as well as their reliability. Toxicological studies in Italy, risk assessment of electronic waste in China, or disposal of bearing lamps in India are some examples of selected scenarios.

All the data gathered during the RISKCYCLE project as well as the results have been presented in the book but at the same time to different international events such as the four international workshops organized by the RISKCYCLE project:

- 1st Riskcycle Workshop: Risk-based Management of Chemicals and Products in a Circular Economy at a Global Scale. Hanoi (Vietnam), 3–6 May, 2010
- 2nd Riskcycle Workshop: Risk of Chemical Additives and Recycled Materials. Shenyang (China), 15–19 November, 2010
- 3rd Riskcycle Workshop: Environmental and Health Risks of Chemical Additives and Recycled Materials. Rio de Janeiro (Brazil), 2–6 May 2011
- 4th Riskcycle Workshop: Sustainable Waster Management. New Delhi (India), 12–13 October

In addition, the RISKCYCLE team also organized a conference in Dresden in May 2012 where the main outcomes of the project were presented to and discussed with the public. Apart from this, other dissemination activities have been carried out during the project such as contributions to other conferences and workshops, exchange of students, publications in scientific journals, and training courses on different methodologies among the partners.

At the end of the project, a set of research gaps to be taken into consideration for the future have been identified such as the lack of data about chemicals in products as well as their emission to the environmental compartments, the need to assess the risk of chemical mixtures and not the chemicals by themselves, or the necessity of optimizing the current legislation on chemicals.

As it can be seen, after 3 years of research, several gaps have been identified and showed the need to continue the research on the chemicals contained in products and transported worldwide. This is the future aim of the RISKCYCLE consortium.

Global Risk-Based Management of Chemical Additives II

Risk-Based Assessment and Management Strategies

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