29 January 2015

German note on sustainable chemistry and sound chemicals management

1. This note features the concept of sustainable chemistry in the context of international chemicals management. The text has been developed on the basis of experiences gathered and research conducted in Germany in recent years from the perspective of policy on chemicals management, relevant science-policy interface and related administration. Starting points are:
   - Sustainability on chemicals management is a matter of shared responsibility between all stakeholders, including from industrial suppliers and users, policy, civil society and consumers.
   - There is a need for a common understanding of the scope and applications of sustainable chemistry.
   - Sustainable chemistry should equally fulfil social, economic and ecological requirements.
2. Whereas the current note is not a policy paper and does not represent an official position of the German government, it may serve as a living document to be used for basic information and elaboration of selected issues related to policy-making, research and industrial activities related to chemicals management.

I Sound chemicals management: A fundamental policy approach for protection of environment and health

3. The sound management of chemicals aims at achieving that, by 2020, chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health, as set forth in the Plan of Implementation of the World Summit on Sustainable Development, and re-affirmed in the outcome document of the United Nations Conference on Sustainable Development entitled "The future we want".
4. States, representatives of civil society and the private sector announced in the Dubai Declaration of the Strategic Approach declared that the sound management of chemicals is essential if we are to achieve sustainable development and announced their determination to realize the benefits of

chemistry, including green chemistry, for improved standards of living, public health and protection of the environment.

5. The achievement of the 2020 goal of sound chemicals and waste management needs urgent and coordinated action by all stakeholders at national, regional and international level, as emphasized by the fourth international conference on chemicals management in its resolution on the implementation towards the achievement of the 2020 goal.
6. The strengthening of the sound management of chemicals in the long term will be of relevance beyond 2020, as acknowledged by the United Nations Environment Assembly in resolution 1/5 on chemicals and waste. In Annex I of this resolution, UNEA recognizes that industry has a special responsibility, as designer, producer and user of chemicals and products, and should apply sustainable chemistry, recognizing the ongoing efforts being undertaken in this regard.
7. The sound management of chemicals is an essential and crosscutting element for the achievement of the 2030 Sustainable Development Agenda, as specifically addressed in target 12.4 on chemicals and waste.

II Sustainable chemistry: Evolution of sound management of chemicals to a holistic approach for fulfilment of sustainable development

II a. Scope

8. Sound management of chemicals is seen as a fundament for sustainable chemistry, the latter serving the fulfilment of sustainable development. In other words, sustainable chemistry is an holistic approach that goes beyond the sound management of chemicals and helps to achieve sustainable development taking into account issues that are not primarily addressed by sound management of chemicals alone, such as e.g. use of renewable resources, energy efficiency, innovative business models.
9. Achievement of the sustainable development agenda will require innovative strategies and attractive solutions for relevant stakeholders, with particular benefits for developing countries and countries with economies in transition through sustainable (including green) chemistry.[1]
10. From the engineering perspective, sustainable chemistry builds upon the principles of green chemistry. In general, green chemistry tackles in the first place engineering and technical issues from the design and production perspective, whereas sustainable chemistry encompasses all

[1] OECD Definition: Sustainable chemistry is a scientific concept that seeks to improve the efficiency with which natural resources are used to meet human needs for chemical products and services. Sustainable chemistry encompasses the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes. Sustainable chemistry is also a process that stimulates innovation across all sectors to design and discover new chemicals, production processes, and product stewardship practices that will provide increased performance and increased value while meeting the goals of protecting and enhancing human health and the environment.

views of a product and its life cycle related to sustainability, e.g. social and economic aspects related to the use of resources, from the perspective of different stakeholders.

11. Sustainable chemistry aims at further reducing any adverse effects on human health and the environment caused by the production and use of chemicals, and at efficient use and protection of resources, by combining social, economic and environmental aspects, on the basis of the precautionary principle. Renewable alternatives may offer feasible solutions for sustainable chemistry.
12. Sustainable chemistry is able to significantly alleviate trade-offs between social and economic benefits of chemicals use *vs* adverse effects on human health and the environment as well as resource consumption.

II b. Linkages to overarching policy areas

13. Sustainable chemistry addresses numerous aspects of sustainable development such as inherent safety of substances and products, the precautionary principle, (eco-) toxicity and substitution of hazardous chemicals, life cycle approach and recycling, resource efficiency (including energy efficiency), bio-renewable and critical raw materials as well as workers safety, training and social responsibility and market opportunities. Successful sustainable chemistry business models like chemical leasing combine social and environmental achievements with economic benefits for all partners. Other positive initiatives include efficient production processes, product life-cycle extension under the re-use and refurbishment schemes, remanufacturing, non-chemical alternatives, industrial symbiosis and other cooperation between various market stakeholders, take-back schemes, service and sharing models, and eco-design. Important challenges remain in substitution of hazardous chemicals in production systems and products and thus in connecting chemistry to a green economy agenda, in accounting for all aspects of sustainable chemistry or in enhancing synergies between the various regulatory systems at regional and global levels so as to connect their strategies to relevant SDG goals and targets.
14. The fulfilment of sustainable development agenda requires innovative efforts connecting sustainable and green chemistry approaches to chemicals management. Increasingly applied along the whole value chain, sustainable chemistry results in easier enabling sustainable consumption and production (goal 12), as well as healthy lives (goal 3), water and sanitation (goal 6), among others.
15. Sustainable chemistry will strengthen the dissemination of information about the economic, health and business benefits and opportunities, and it will improve the flow of information among suppliers and producers. Moreover, sustainable chemistry will join partnerships which tackle priority challenges for growing itself in the marketplace, as exemplified by the SAICM Emerging Policy Issue Chemicals in Products.

II c. Relevance for developing countries and countries with economies in transition

16. Early introduction of sustainable chemistry will enable developing countries and countries with economies in transition to set up a protective sound chemicals management from the start, taking into account the resulting social and economic benefits (e.g. reduced burden of disease, good management practices in agriculture). Sustainable chemistry can boost capacity building (e.g. the Global Environment Facility - GEF, and EU Neighborhood/Accession policy have helped to improve chemicals management systems in parts of the Pan-European region), technical assistance, and technology transfer for particular benefits in developing countries. This process will gain additional value, when multi-actor/multi-sector approaches are initiated, such as those currently ongoing under SAICM.
17. For developing countries and countries with economies in transition sustainable chemistry encompasses the opportunity to strengthen frameworks for innovation in product design and value-chain management through best available technique (BAT) and Integrated Environmental Management schemes, and the transition to safer alternatives as laid down i.a. in the Stockholm Convention on POPs or the Minamata Convention on Mercury.

II d. Examples of applications

18. Significant contributions of sustainable chemistry, including good management practices, to a better environmental performance (waste and water treatment, reduced emissions, energy efficiency) are achieved by application of best available techniques (BAT) for the textile industry in Europe. The potential for applications of sustainable chemistry in the textile industry is even higher in developing countries and countries with economies in transition s. National or international activities (e.g. Zero Discharge of Hazardous Chemicals) aim at higher standards of environmental performance for the global apparel and footwear industry.
19. Substitution of PFOS additives with fluorine-free alternatives has been implemented successfully in many cases of manufacturing with electroplating chemicals over the past years. In particular, alkyl sulfonates may be viable substitute for PFOS in the case of decorative chrome-plating or even hard chrome plating, the latter being of crucial importance for many industrial processes. Thus, substitution of PFOS in the electroplating sector is a promising application of sustainable chemistry that could be encouraged by promoting existing, fluorine-free surfactant alternatives.
20. Sustainable chemistry makes important contributions to the synthesis of pharmaceuticals. In this context, design of active pharmaceutical ingredients (API) takes into account their fate after use (or non-use) in the environment.
    - Example cytostatic agent gluphosphamide (ß-D-glucosylisophosphoramidmustard: ß-D-Glc-IPM). In this case the stereochemistry is of importance, not only for the molecule's activity but also for its biodegradability. Gluphosphamide was developed from ifosfamide, which is one of the classical alkylating cytostatic agents. The goal of the structural change was to

improve its pharmacological properties, such as uptake in the bowel, in order to reduce undesired side-effects. It has been found that the ß-D-Glc-IPM not only has the desired pharmacological properties, but it is also much more biodegradable than ifosfamide, which is not biodegradable, as are most other cytostatic agents studied to date.

21. Chemical leasing is a service-oriented business model, which combines economic benefit for involved stakeholders (supplier and users of chemicals) with better environmental performance (energy efficiency, reduced emissions and waste) and reduction of risks for health and environment. It is already successfully applied in industrialised countries, developing countries and countries with economies in transition, in various sectors, such as production of petrochemicals (oil dehydration, water clarification, corrosion inhibition), automotive industry and manufacturing (surface treatment, cleaning, coating), food industry (lubrication of conveyors), agriculture (plant protection) or tourism (laundry processes).
    - Example paint solvents. A company may not buy solvents. Instead it leases them and returns them to the deliverer after usage. Taking back the solvent has the advantage for the deliverer that he can use all his solvent related knowledge and experience to make them most effective (e.g. solvent selection). Now he or she has an interest to have most efficient use of solvents for a specific application. The leasing company has the same interest. This is a win-win situation – just selling a solvent is a win-loose situation: the provider wants to sell as much solvent as possible, the customer as little as possible.
    - Example use of disinfectants. A provider wants to sell as much disinfectant as possible. However, the goal behind the application of disinfectants is to safeguard a proper standard of hygiene. If the provider of the disinfectant is responsible for providing the necessary standard of hygiene he will aim to use as little disinfectant as possible. The manufacturer of a disinfectant has lots of knowledge about disinfectants and regulation on hygiene. Therefore, he can provide training and education on the right use of disinfectants and application of other measure to maintain the necessary hygienic standards. In fact he can save money be spending less for the raw materials and synthesis/manufacturing of the disinfectant and earn more by selling a service – the maintenance of the appropriate standard of hygiene. Furthermore, less physical resources were needed; less energy for synthesis and delivery, less packaging material and less emission of chemicals into the aquatic environment will result.