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2013COPs sustainable synergies

Chemicals' Life-Cycle Brief

United Nations Environment Programme

Secretariat of the Basel, Rotterdam and Stockholm Conventions

Geneva and Rome

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1. What are Chemicals?

All living and inanimate matter is made up of substances that are formed by different combinations of the more than 100 elements found in our world, such as the two major components of the air we breathe – nitrogen (~80%) and oxygen (~20%). Simply stated, a chemical may be either an element or a compound that is formed by a combination of elements.

- An organic chemical includes carbon in it. While commonly found in living organisms (e.g. DNA, hormones, proteins, fats), hundreds of thousands of synthetic organic compounds have been produced by industry (e.g. DDT insecticide, polyvinyl chloride (PVC) polymer).
- Inorganic chemicals do not include carbon. There are thousands of natural and synthetic inorganic chemicals (e.g. borax, chlorine, sulphuric acid) and compounds of metals are common examples (e.g. sodium chloride, better known as table salt).
- Organometallic compounds include both metals and carbon (e.g. tetraethyl lead was once widely used as an octane enhancer in motor gasoline).

2. What happens when chemicals are released to the environment?

Upon release into the environment, either directly or as waste, a chemical will be subject to natural transformation and transportation processes that are influenced by:

- the conditions under which the chemical or chemical waste is released to the environment (e.g. to air, water or soil; from a limited number of point sources vs. a large number of diffuse sources);
- environmental conditions (e.g. temperature of the receiving media, season, amount of sunlight); and
- the specific physical and chemical properties of the chemical.

As a result of the effects of these various factors, a released chemical will be:

- distributed in different media (i.e. air, water, sediment, soil, plants, animals, humans);
- transported over short or long distances as a result of natural environmental processes, usually involving air and/or water; and
- transformed and degraded into other chemicals.

Eventually, as a result of this multimedia behaviour, the chemical and its transformation products will be distributed between soil, sediment, water, air, plants, animals and humans.

3. Why are chemicals of interest today?

Since the large scale production of chemicals began in the middle of the 19th century, the use of chemicals has grown steadily and chemicals have now become an essential component of modern societies, serving in a wide variety of roles that establish and/or preserve an elevated standard of living in countries at all stages of development.

Virtually every man-made product involves the use of chemicals in some manner and new chemicals are developed every year in response to the constant demands for new and improved materials (e.g. plastics, cosmetics, drugs), enabling advances to be made in such high technology areas as health care, bio-engineering, electronics and telecommunications.

However, the large scale production and use of chemicals has been accompanied by the release to the environment of many chemicals that have degraded environmental media and resulted in the exposure of humans and wildlife to levels of chemicals that cause adverse impacts on human health and the environment. As a result, numerous hazardous and toxic chemicals have become priorities for risk management action at the national and international levels.

In addition to the tens of thousands of chemicals that are intentionally produced for commercial purposes, some chemicals are unintentionally produced as by-products in industrial, manufacturing and combustion processes. These chemical by-products may be present as contaminants in products, articles and wastes or be released directly into the environment, thus contributing to the burden of chemicals in the environment and, ultimately, to the exposure of humans and wildlife. Some by-products, such as polychlorinated dioxins and furans, have been identified as toxic to humans and wildlife and are priorities for risk management action at the national and international levels.

Public concerns about the adverse impacts of chemicals on human health and the environment have made the sound management of chemicals and their associated wastes an essential component of overall public policy in countries at all stages of development. While chemicals can make significant contributions to resolving many modern issues (e.g. the use of pest control products to control vector borne diseases such as malaria), if not properly managed they can cause significant damage to human health and the environment.

4. How can the risks of chemicals be identified?

To assess the health and environmental risks of chemicals, their physical, chemical and toxicological properties need to be assessed along with estimates of exposure of humans and environmental organisms.

Because the specific properties, release conditions and environmental fate are unique to each substance, chemicals need to be assessed systematically to see whether they will be broadly distributed following release to the environment or will preferentially concentrate in one medium (air, water, sediment, soil, or biota). Such systematic assessments can identify the nature and extent of local, regional and global impacts of chemicals that are released to the environment.

In assessing the risks posed by a chemical it is important to consider releases from the widest range of activities including during manufacturing and processing, handling and transportation, accidents involving manufacturing and transportation, the use of products and articles, and disposal of wastes from manufacturing processes and from the end-of-life stage of products. This is sometimes referred to as assessing the “life cycle” of the chemical.

5. What types of chemicals pose risks to health and the environment?

The following are examples of types of chemicals that have been shown to pose unacceptable risks to human health or the environment.

- While many chemicals degrade quickly in the environment, some are released in quantities, concentrations or under conditions such that elevated concentrations are sustained in environmental media, causing adverse effects on humans and/or wildlife.

- Some chemicals have a combination of physical and chemical properties such that once released to the environment, they degrade very slowly and remain in environmental media and organisms for years or even decades, even when released in relatively small quantities: such chemicals are said to be persistent. These chemicals can be distributed by natural environmental processes over long distances, leading to regional and global contamination of environmental media, foods, wildlife and humans.

- Some environmental contaminants are taken up from water or food and are retained by wildlife and/or humans in their bodies at concentrations higher than the concentrations in their food and water: such chemicals are said to be bioaccumulative and they can cause adverse affects when levels become sufficiently elevated.

- When predators at higher levels in the food chain consume contaminated wildlife, they can acquire very high body burdens of some chemicals: this effect is referred to as biomagnification and it can lead to serious adverse effects including birth defects and reproductive failure.

- on recent decades, increased attention has been paid to addressing the risks posed by substances that are persistent, bioaccumulative and toxic as wide-spread exposures can occur over extended time periods – affecting generations of humans – and cause toxic effects. Examples of such chemicals include persistent organic pollutants (POPs) and some metal compounds like mercury.

- While some chemicals can cause direct adverse affects on wildlife or humans, others can cause changes in the environment that present hazards to humans or wildlife. Examples include volatile organic chemicals and oxides of nitrogen, which give rise to tropospheric ozone (or "smog"), and chlorofluorocarbons (CFCs), which degrade the stratospheric ozone layer allowing increased ultraviolet radiation to impact on the earth's surface.

- There are some environmental pollutants for which science has been unable to demonstrate a "no effect" level on humans (e.g. sulfate particles in air, blood lead levels in children).

6. What can be done to address the risks posed by hazardous and toxic chemicals?

The wise use of chemicals is important in establishing and maintaining a higher standard of living in countries at all stages of development. However, the failure to properly assess and manage the risks posed by the use and possible release to the environment of chemicals can seriously undermine sustainable development initiatives at the national, regional and global levels.

Governments are paying increasing attention to the need to take risk management actions to protect their populations and environment from the threats posed by toxic chemicals. Risk management actions include the development of measures to prevent or control the release of problem chemicals at appropriate stages in their life cycle – including research and development, production, transportation, use and waste disposal.

7. The hazardous chemicals and wastes conventions

In addition to actions at the national level, several international agreements and programs are being implemented to address the risks associated with those chemicals that are of international concern due to their regional or global impacts on health and the environment or the need to minimize and if possible to avoid impacts on health and the environment. Three relevant examples of multilateral international agreements are:

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal;

The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; and

The Stockholm Convention on Persistent Organic Pollutants.

The Basel, Rotterdam and Stockholm conventions are distinct and legally autonomous multilateral environmental agreements that share the common objective of protecting human health and the environment from hazardous chemicals and wastes for the promotion of sustainable development. The conventions can assist countries in safely managing chemicals at different stages of their life cycle.

The Basel Convention

propagates the minimization of hazardous wastes and ensures that strong controls are applied from the moment of generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery and final disposal. The convention does this by:

- regulating the transboundary movements of hazardous and other wastes by applying the "prior informed consent" (PIC) procedure, under which:
    - only shipments between consenting Parties are legal and all shipments made without such consent are illegal; and
    - shipments to and from non-Parties are illegal unless there is a special agreement;
- requiring Parties to ensure that hazardous and other wastes are managed and disposed of in an environmentally sound manner by:
    - minimizing the quantities of wastes that are moved across borders;
    - treating and disposing of wastes as close as possible to their place of generation; and
    - preventing or minimizing the generation of wastes at source.

The Rotterdam Convention

promotes shared responsibilities and cooperative efforts among Parties in the international trade in certain hazardous chemicals through

- facilitating information exchange on a broad range of chemicals that have been banned or severely restricted in order to strengthen national decision making on chemicals management;
- the prior informed consent or PIC procedure providing importing Parties the power to take informed decisions on those chemicals they want to receive and to exclude those that they cannot manage safely and a means for formally obtaining and disseminating these decisions.

The Stockholm Convention

addresses the production, use and release of persistent organic pollutants (POPs) and requires Parties to the convention to:

- restrict or eliminate production and use of intentionally produced POPs;
- reduce unintentional production of POPs, with the aim of eliminating releases to the environment; and
- ensure stockpiles and wastes that contain POPs are managed safely and in an environmentally sound manner to reduce or eliminate releases to the environment.

The three conventions address complementary aspects of managing the risks of hazardous and toxic chemicals and their disposal, an example is included in the box below.

Box 1. Managing the risks posed by polychlorinated biphenyls (PCBs) through collaboration under the Basel, Rotterdam and Stockholm conventions

Managing the risks posed by polychlorinated biphenyls (PCBs) through collaboration under the Basel, Rotterdam and Stockholm conventions

When the Stockholm Convention entered into force in 2001, it included comprehensive

risk management measures for PCBs - synthetic industrial chemicals that were widely used in most countries in industrial equipment such as electrical transformers and capacitors. Parties to the Convention are committed to phasing out the use of PCB-containing equipment by 2025, and to concluding the environmentally sound management of the waste materials by 2028.

The Rotterdam Convention promotes shared responsibility and cooperative efforts by allowing Parties to take informed decisions to control international trade in PCBs and, in this way, contributes to their environmentally sound use.

Guidance for the management of PCB wastes is provided by the Basel Convention, and any proposed exports of PCB-containing wastes require prior notification under the Basel Convention.

8. The synergies process

To enhance cooperation and coordination among the Basel, Rotterdam and Stockholm conventions, their respective conferences of the Parties have taken a series of decisions initiating what is collectively known as the "synergies process". The synergies process aims to strengthen the implementation of the three conventions at the national, regional and global levels by providing coherent policy guidance, enhancing efficiency in the provision of support to Parties to the conventions, reducing their administrative burden and maximizing the effective and efficient use of resources at all levels, while maintaining the legal autonomy of these three multilateral environmental agreements. This unique approach is a successful example to other parts of the global environmental agenda and demonstrates how to enhance international environmental governance through coordination and cooperation.

Some examples of benefits of the enhanced coordination and cooperation among the hazardous chemicals and wastes conventions for countries include:

- improved use of available resources through more coordinated national frameworks, institutional mechanisms and enforcement capacity dealing with chemicals and wastes;
- raised profile of the issue at the national and international levels which can result in increased resources to support chemicals and waste management programmes;
- better coordinated technical assistance activities and better use of resources to support developing countries and countries with economies in transition to implement the conventions;
- more integrated approach towards sound chemicals and wastes management and the opportunity to mainstream those issues into national development plans;
- more cost-effective implementation of the conventions through synergistic efforts.