Feedback

send a general website comment

report a specific problem with this page

Endocrine disrupting Chemicals (EDCs) and Persistent Organic Pollutants (POPs).

Endocrine disruptive chemicals (EDCs) are considered quite dangerous for animals and human beings. These chemicals act like hormones, which in minute quantities control our growth, metabolilic and reproductive functions.

While EDCs include heavy metals such as cadmium and lead, they specifically refer to numerous basic chemical constituents used in our economy. Examples are phthalates and bisphenol A, of which millions of tonnes are used each year to produce plastics. These substances are found in plastic toys, floor coverings and raincoats; in pesticides, animal feed, cosmetics and medicines.

All over the world, since the 1990s increasing amounts of EDCs have ended up in our rivers and other water bodies where they have threatened both animals and humans. Hormonally active chemicals in drinking water can interfere with metabolism and the immune system. They can cause men to grow breasts and can lead to cancer, genetic damage and deformities.

Some especially dangerous EDCs are called Persistent Organic Pollutants, or POPs. Scientists have listed a group of hormonally-active POPs – among them a number of pesticides, which have been banned worldwide. POPs are covered by the **Stockholm Convention on Persistent OrganicPollutants (**www.pops.int**)**, which is a "global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have adverse effects to human health or to the environment. (Stockholm Convention 2010)

Further information on major POPs and guidance on risk assessment and site remediation methods can be found on the POPs Toolkit.

Discarded barrels that were used to contain Persistent Organic Pollutants (POPs) can become a source of contamination.
Source:©iStockphoto/Urbanija 2006
(click to enlarge)

Extremely Malicious Pollutants: POPs

Of all the pollutants released into the environment every year by human activity, persistent organic pollutants (POPs) are among the most dangerous. POPs are either used as pesticides, in industry, or generated unintentionally as by-products of various industrial/combustion processes.

POPs are toxic, causing an array of adverse effects, including death, disease, and birth defects among humans and animals. Effects may include cancer, allergies and hypersensitivity, damage to the central and peripheral nervous systems, reproductive disorders, and disruption of the immune system. All POPs are EDCs.

These stable compounds can persist for many years before breaking down. They circulate globally through a process known as the 'grasshopper effect'. POPs released in one part of the world can, through a repeated (and often seasonal) process of evaporation and deposition, be transported through the atmosphere to regions far away from the original source.

POPs are also problematic because they concentrate in living organisms through bioaccumulation. Though not soluble in water, POPs are readily absorbed in fatty tissue, where concentrations can become magnified by up to 70,000 times the background levels. Fish, predatory birds, mammals, and humans are high up the food chain and so absorb the greatest concentrations. When they travel, POPs travel with them. As a result, POPs can be found in people and animals living in remote regions such as the Arctic, thousands of kilometres away from any major POPs source.

Box: Organic Pollutants in the Basin

Teams of highly trained scientists took samples from aquatic birds, fish tissue and from sediments. These samples were carefully prepared and sent to a laboratory in Germany, where they were analysed with sophisticated apparatus for a range of organic pollutants; such as DDT, Dioxins, and a range of other organic pollutants.

Interactive

Basin Map
Explore the sub-basins of the Orange-Senqu River
enter

Video Tour
Tour video scenes along the Orange-Senqu River related to the River Basin
enter

Geography Maps
Investigate land cover and terrestrial ecoregions in the basin
enter

Water Cycle
Examine how the hydrologic cycle moves water through and around the earth
enter

Food Web
Explore the interactions of living organisms in aquatic environments
enter

The sediments throughout the basin generally had very low levels of organic pollutants. However, certain sites showed spikes in some of the organic pollutants. In particular dioxins (which are caused by low heat burning of plastics) are higher (over 0.3) near urban centres. However, further investigation will be necessary to identify the actual sources of these substances.

As with the metals, Dioxin concentrations in the lower Orange River are lower, and there does not seem to be significant transport of these substances through the river system. Spikes in PCBs are also noted in parts of the North West Province of South Africa, however, there is no immediately obvious cause for this.

Fish tissue also had relatively low levels of organic pollutants, except for higher than expected levels of some contaminants near Rooipoort in the Northern Cape Province. Again, the potential source of this pollution needs to be determined.

Bird eggs taken from breeding colonies in Bloemhof Dam, and near Potchefstroom also showed some spikes in organic pollutant concentrations. The sources of these pollutants are again unclear. There is however evidence of bio accummulation in fish and bird eggs.

Concentrations of organic pollutants are, for most of the basin, quite low. The JBS-1 has nevertheless shown that spikes of important organic compounds suggest sources of pollution in areas that would otherwise be considered clean.

Source: ORASECOM 2011

To access an overview of the water quality situation in the Orange-Senqu River basin, please consultant the: *"The State of the Orange Senqu River system – A Report on ORASECOM's First Joint Basin Survey JBS-1, Centurion 2011",* in the Document Library.

EDC and POPs Legislation

There is no specific legislation dealing with EDCs and POPs in the countries of the Orange-Senqu River basin. Also in South Africa, with its sophisticated water law of 1998, legislators still need to find a way to address the problems presented by EDC and POPs. No limits have been set for EDCs in South Africa, and water quality guidelines make no reference to these substances.

It is rare that waterbodies are tested for EDCs or POPs, even in regions like Gauteng in South Africa. POPs analysis can be expensive; and for some tests, the laboratories in the basin states lack the equipment to undertake the necessary analysis. However, there are several examples where researchers found significantly high quantities of EDCs and POPs in waterbodies. One of the best known examples is that of Rietvlei Dam.

Example from Rietvlei Dam, South Africa

In 2007, researchers from the Water Research Commission (WRC) and other research institutions investigated the waters of the Rietvlei Dam; an important source of drinking water for the City of Tshwane (Pretoria). The dam is located in a seemingly idyllic location, in a conservation area south of the city, but is surrounded by industry and sewage treatment plants.

The survey of the dam found POPs such as DDT and Endrin, as well as heavy metals such as mercury, lead, cadmium and arsenic, plus high volumes of hormones. According to the research report, the hormones were present “at levels up to 10 000 times higher than those known to initiate cancerous activity in breast cells".

The researchers found that the combination of chemical substances was having a profound impact on wildlife in the reserver. For instance, they found malformed fish and snails without penises, and 30 percent of catfish in the lake were hermaphrodites - had both male and female sex organs. And even though malaria is not a major problem in Pretoria, large amounts of DDT (a chemical compound often used to kill insects that carry malaria) were found in catfish and eland. The eland also had heavily calcified testes.

The team did not see this as a health hazard for the citizens of Pretoria, because the water treatment plant serving Rietvlei Dam makes use of modern activated-carbon filters. Provided that they are working as intended, these facilities remove EDCs. In addition, drinking water sourced from the Rietvlei Dam is currently diluted with large amounts of unpolluted water transferred into the Vaal River sub-basin from the Lesotho Highlands Water Project.

In spite of these facts, the researchers wrote: “It must be recognised that a large percentage of the population still remains dependent on untreated water from streams and rivers. They are, therefore, exposed to these chemicals.” The WRC warned against using Rietvlei water for irrigation, and called on responsible parties to reduce the amounts of hormonally active substances released into the environment.

After some media publications released editions cover the issue, especially Mail & Guardian newspaper (11 May 2007 edition), the names of Rietvlei dam and the nature reserve were dropped from the title of the official WRC research report - “The use of sentinel species to determine the endocrine disruptive activity in an urban nature reserve”. It is unknown, if any action was taken against the polluters.

Following the above media coverage, the WRC released a strongly worded Media Release defending the work and clarifying certain elements published in the Mail and Guardian article.

An Urgent Need to Act

South Africa’s EDC and POP-related challenges continue to escalate, particularly in Gauteng Province. Scientists see an urgent need to conduct rigorous and geographically comprehensive studies on the occurrence of these substances in watercourses across the region. These challenges make it even more urgent to modernise water purification systems in the region as soon as possible. The countries of the Orange-Senqu River basin also require modern laboratories and

highly qualified experts who monitor the behaviour on industry, and assist them to develop environmentally responsible pollution treatment and control systems.

To achieve this, the countries require modern technology and a considerable amount of financing. Even the repair of existing water treatment plants in South Africa is likely to cost over 100 billion Rand, as estimated by experts at the University of Cape Town. One of the most concerning results of resoving these issues would be that the cost of these upgrades would most likely be passed on to the consumer and most experts agree that water will undoubtedly become more expensive. In order to avoid significant cost increases, governments across the region will likely need to cooperate with industry and International Cooperation Partners (ICPs) to reach a solution.

Questions to the Minister

A good insight into the issue of EDCs and POPs is provided by the **answer of the Minister of Water and Environmental Affairs, B P Sonjica to a parliamentary question by M.P. G R Morgan**. This answer was released on 14 October 2007:

Box: Statement of South Africa's Government on EDCs and POPs

NATIONAL ASSEMBLY

FOR WRITTEN REPLY

QUESTION NO 1446

DATE OF PUBLICATION IN INTERNAL QUESTION PAPER: 25 SEPTEMBER 2009

(INTERNAL QUESTION PAPER NO 18)

Mr G R Morgan (DA) to ask the Minister of Water and Environmental Affairs:

(1)(a) What is the extent of endocrine disrupting compounds[1] (EDCs) in each river in (i) Limpopo, (ii) Mpumalanga and (iii) Gauteng and (b) what are the effects of the presence of EDCs (i) in water and (ii) on human health;

(2) whether any efforts are being made to (a) reduce the levels of EDCs in these water sources and (b) warn people of the health consequences of drinking this water; if not, why not; if so, what are the relevant details? NW1804E

REPLY:

(1)(a)(i) Currently only limited data is available on the extent of EDCs in the Limpopo catchment. The source thereof is the current Water Research Commission (WRC) study focusing on areas where DDT is used for indoor-spraying to control malaria.

(1)(a)(ii) Pesticides (e.g. BHC Lindane, DDT, DDD, DDE, Dieldrin, Endosulfan, Heptachlor) with EDC properties have been found in the Crocodile River (Heath *et al*, 2003). Among these DDE (a breakdown product and impurity in commercial DDT mixtures) has the highest anti-androgenic effect and this is about one ten millionth the potency of 17, beta estradiol (*Endocrine Disrupting Compounds: Priority List of EDCs. Prepared by: Water Research Commission (South Africa) in cooperation with: Kiwa Water Research (Netherlands) and TWZ – Water Technology Center (Germany)*, September 2003.

In the Inkomati and Olifants Water Management area, EDC is indirectly introduced by the use of pesticides from the agricultural activity (i.e. grapes, citrus, nuts etc) in the area. As agriculture occurs in these catchments, it has been identified as a source of diffuse pollution with some levels of pesticides used finding their way into the Water Resources.

(1)(a)(iii) Currently, there are no EDCs testing for Gauteng Rivers. The preceding study was conducted by the Water Research Commission (WRC) at the Rietvlei Dam in 2008. The proximity thereof to the research institution was one of the reasons for selecting the dam. This is attributed mainly to the costs and the complexity associated with conducting the test. Also, as there was no controlled 'clean' site that could be found for the study, controls were thus generated in an artificial laboratory environment.

(1)(b)(i) Studies have been done in species living in or closely associated with the Aquatic Environment. Health effects vary from subtle change in physiology and sexual behavior of species to permanently altered sexual differentiation. A range of effects can be seen in laboratory populations but it has been difficult to establish direct causal links to specific chemicals in field populations.

-2-

(1)(b)(ii) There is still a scientific debate on potential impact to humans as the argument that if the EDCs affect aquatic species then they might also be affecting humans. Some EDCs may possibly have trans-generational capabilities and thus can affect up to 3 generations under highly conservative scenarios. This makes it difficult to undertake control experiments on humans. The other complicating fact is that humans are generally exposed to EDCs in the form of pharmaceuticals (e.g. birth control pills), personal care products and industrial substances (e.g. fabric softeners and plasticisers) at some point in their life. It becomes difficult to specifically link the exposure route to particular dosages that may pose major health effects. There are significant issues related to effects of mixtures of chemicals and their effects on populations. As a result risk analyses in environmentally typical exposure situations have often been equivocal.

(2)(a) My Department has an established monitoring programme for Toxicity. The WRC is funding research through universities and the Council for Scientific Industrial Research (CSIR) to quantify the impact on specific rivers. The pilot phase of the national Toxicity Monitoring programme focused on the detection of persistent organic pollutants (POPs) in order to contribute to the South African report in terms of the Stockhölm Convention. In terms of the study the proposed hot-spot areas selected around Guateng, Mpumalanga and North-West showed the streams were typically in a good state. As the worst case one site could be described as "fair" another as "poor" while the other four sites were still in a good state. The details can be found in: Jooste S, Bollmohr, S and Thwala M (2008) *National Toxicity Monitoring Program: Report on Phase 3: Pilot*

Implementation and Testing of the Design. Report No. N/0000/REQ1008. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

In addition, the Department does routine monthly water analysis for chemical and microbiological testing. Where there are high levels of these compounds, a possible source is investigated and appropriate actions taken to ensure that the level of these compounds is reduced.

Conventional treatment (treatment of Waste Water) reduces some level of the EDCs thus reducing the levels that are discharged into water resources. Some EDCs may have an impact on at extremely low levels, often in the pg/kg dose range (a picogram is a millionth of a millionth of a gram). This means that concentrations in water well below chemical detection limits might be beyond the capability of all but the most sophisticated waste treatment facilities to remove some EDCs. In spite of this, one South African study has shown reduced and/or complete removal of estrogenicity by the water treatment process and significant removals were observed after chlorination. Technologically endocrine disruption other than estrogenicity and anti-androgenicity are very difficult to determine and no South African and indeed very few other studies exist.

The banning of EDCs (e.g. DDT) use for agricultural purposes also contributes to keeping the levels of EDCs lower that could have found their way into the water resources however DDT is still being used for vector (malaria) control. The few chemical analytical data on surface water suggest that the continued illegal use of banned pesticides may contribute to some the POPs observed in surface waters in South Africa, although DDT (both a POP and an EDC) can be transported over long distances through atmospheric processes.

(2)(b) My Department discourages any form of contact sports like swimming in, or drinking water from rivers. This is to prevent/ reduce the chances of being in contact with contaminants which might results in some form of infection as a result of pollutants in the water.

-3-

To deal with pollution related problems and to speed up the response time, my Department also engages with the municipalities and other stakeholders through forums to identify the sources of pollution and integrating monitoring programmes to pick up pollution quickly and respond appropriately.

In the Rietvlei Dam where water is used for drinking purposes, water treatment plant uses multiple barriers and the best available technology to ensure that the water purified in the treatment process is of the best quality. The best available technology accessible, as recommended by the United States Environmental Protection Agency (USEPA), for removal of EDCs, as well as a number of other contaminants is used. This technology has been in place at Rietvlei Water Treatment Plant since 1999.

The Water Research Commission has conducted research studies into EDCs in South Africa. The research results are available in the public domain and there were media articles (e.g. Rietvlei story half-baked, Mail & Guardian 25 - 31 May 2007) and scientific debates after these reports were released. Media plays a big role in bringing awareness to issues affecting the society at large. The bigger picture on benefits of using EDCs such DDT vs costs of not using DDT (malaria deaths) should be considered especially for this developing country. The World Health Organization is in agreement with the continued responsible use of DDT for this purpose. The WRC, with support from My Department, is currently working on projects that might contribute to a risk-benefit study on particularly the estrogenic DDT and its congeners. In addition, some of these EDCs will be addressed in the proposed review of the South African Water Quality Guidelines.

The other forms of public awareness are done through the Departments of Agriculture, Forestry and Fisheries (e.g. the South African Pesticide Initiative Program) and the Department of Health (e.g. malaria control using DDT).

Next: Acidity, Heavy Metals and Radionuclides