Conclusions

1) **Increased levels of heavy metals were found in river sediments.** The most widespread is cadmium, followed by zinc. Concentration of heavy metals in multiple sediment samples exceeds various legal standards, most frequently Czech limit levels for use of sediments on agricultural soils, but in some cases also the Ukrainian allowable concentrations of sewage sludge used as fertilizer, Ukrainian maximum permissible concentrations in agricultural soils, and US Environmental Protection Agency (EPA) level of pollution limit for non-industrial areas. The most polluted sediments were found in Kharkiv and Zaporizhia.
2) **Levels of zinc and lead in few sand samples exceeded the Czech hygienic limits for sand on playgrounds** in Dnipro and Mariupol.
3) **There is a widespread pollution with petroleum hydrocarbons** in industrial cities. The most extensive pollution was found in Kharkiv and Zaporizhia.
4) **Residues of DDTs** found in one sediment sample from Kharkiv and four samples of the sand from playgrounds from Dnipro.
5) Risk analysis indicated that **pollution caused by arsenic, followed by cadmium, is the most dangerous**. Several sediment samples polluted with arsenic showed that adverse carcinogenic effects may occur in the long term. Few sediment samples polluted with cadmium showed exceeded hazard quotient; it indicates potential adverse health effects. The severity of the risks depends on the particular use of the site.
6) **Serious contamination of free-range poultry egg samples by dioxins** and dioxin-like PCBs in Kharkiv, Mariupol and Kryvyi Rih discovered. Contamination with persistent organic pollutants may occur also in other home-grown food sources. The situation in Kryvyi Rih is most disturbing.

Recommendations

- To identify potential sources of pollution
- **To carry out ongoing research** to detect other possible places with contamination and the spread of contamination resulting in any toxic threats to human health and environment in the future
- **To organize broader sampling** to get more complex picture on possible food contamination
- To implement improvement assessment for **better environmental practices in industrial cities**
- **To improve the technologies in heavy industrial plants**, using the best available techniques and best environmental practices, e.g. decrease emissions of dust that carry dangerous contaminants, such as heavy metals and dioxins

Full version of both studies can be downloaded at:

Industrial Ukraine. Impact of pollution on inhabitants and the environment in five industrial cities:
https://english.arnika.org/publications/industrial-ukraine-impact-of-pollution-on-inhabitants

Use of free range poultry eggs as the indicator of the pollution in Eastern Ukraine.
https://english.arnika.org/publications/eggs-as-the-indicator-of-the-pollution-in-eastern-ukraine

Eggs

Playgrounds

Impact of pollution on inhabitants and the environment in five industrial cities of Ukraine (2018)

Kharkiv – Dnipro – Zaporizhia – Kryvyi Rih – Mariupol

Two studies produced by **Arnika** (Czech Republic) and **Ecoaction** (Ukraine) in cooperation with the **University of Chemistry and Technology Prague** and the **Coalition Stop Poisoning Ukraine**

AUTHORS: Mgr. Václav MACH, Ph.D., Ing. Marek ŠÍR, Ph.D., Maksym SOROKA, M.S., RNDr. Jindřich PETRLÍK and a team of co-authors

ARNIKA ekодія TRANSITION UNIVERSITY OF CHEMISTRY AND TECHNOLOGY PRAGUE

Photos: Stanislav Krupař/Arnika

Possible sources of pollution

- metallurgy
- thermal power plants
- potential co-incineration of waste in cement kilns
- mining
- coke production

Chernihiv:
Background samples

Kharkiv (12 samples):
Increased levels of zinc and cadmium in all sediment samples and other heavy metals in at least few samples. Concentration of cadmium exceeds Czech and Ukrainian limit levels. Levels of dioxins and dioxin-like PCBs in free range chicken eggs exceeding by more than double of the legislative limit for food, and reaching almost triple of tolerable daily intake of dioxin-like compounds for adults and sixfold of limit for children.

Dnipro (18 samples):
Four sediment samples increased levels of zinc, chromium, arsenic, and lead. Two samples of the sand from playgrounds elevated levels of zinc and lead; one of them exceeds the Czech limits.

Kryvyi Rih (15 samples):
Serious contamination of free-range chicken egg samples by dioxins and dioxin-like PCBs discovered. The measured concentrations exceed by sevenfold of the legislative limit for food, sixfold of tolerable daily intake of dioxins-like compounds for adults and twelvefold of the limit for children. Also, increased levels of organochlorinated pesticides and DDT and, in particular, its metabolites were found.

Zaporizhia (23 samples):
Levels of heavy metals in sediments are generally increased; the most widespread is cadmium (the concentrations in five samples exceeded the Czech limit). The concentrations of zinc in three sediment samples exceeded the Czech limit.

Mariupol (15 samples):
The levels of zinc, cadmium, lead, chromium, arsenic, and mercury in five sediments samples increased; two samples exceeded some legal standards. Elevated levels of zinc and arsenic found in two samples of the sand from playgrounds; both exceed the Czech limits. Elevated concentration of dioxins and dioxin-like PCBs were measured in turkey eggs.

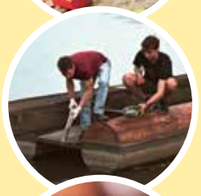
Overview of the research

5 cities

88 samples

Samples:


sand from playgrounds


river sediments


free-range poultry eggs

Pollutants:

8 heavy metals: zinc, cadmium, copper, nickel, lead, chromium, arsenic, mercury

petroleum hydrocarbons: **C10 – C40**

persistent organic pollutants: **DDT** (organochlorine pesticide), polychlorinated biphenyls (**PCBs**)

4 groups of persistent organic pollutants: chlorinated dioxins and dioxin-like **PCBs**, hexachlorobenzene (**HCB**), hexachlorocyclohexanes (**HCH**)

Assessment:

- comparison with background levels
- comparison with legal standards
- auxiliary evaluation criteria
- carcinogenic and non-carcinogenic risks calculation
- calculation of daily intake of dioxins by consumption of contaminated eggs from sampled sites (comparison with suggested intake level in the EU)