

**ISTC Project No. K-1240p**

**”Post-containment Management and Monitoring of Mercury  
Pollution in Site of Former PO “Khimprom” and Assessment  
of Environmental Risk Posed by Contamination of  
Groundwater and Adjacent Water Bodies of the Northern  
Industrial Area of Pavlodar”**

**Unrestricted Summary of Technical Report**

**on the work performed from October 05, 2005 to December 31, 2009**

**Authorized for publication**

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Title of the Project: Post-containment Management and Monitoring of Mercury Pollution in Site of Former PO “Khimprom” and Assessment of Environmental Risk Posed by Contamination of Groundwater and Adjacent Water Bodies of the Northern Industrial Area of Pavlodar

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### **Objectives / scope of work and technical approach / expected results**

**I.** Identification and assessment of the risk associated with the spread of groundwater plumes contaminated with mercury and oil products, including their movement through wells of a water supply system of Pavlodarskoye village, and further towards the Irtysh River and/or their rise onto the pastures and, if significant, identification of a management strategy to contain or minimize the risk; **II.** Identification of a management strategy for containing the environmental risks caused by mercury pollution of a wastewater storage pond Balkyldak including pollutants bioaccumulation via food chains.

During sampling and chemical analyses methods recommended by US EPA will be used as well as standard procedures on Quality Control/Quality Assurance accepted in the West. Determination of mercury in solid samples, water samples and biological tissues will be carried out using AFS analyzer (PS Analytical Millennium Merlin System). Chemical analysis of oil products' concentration in water will be conducted using CG "Hewlett Packard", USA.

Assessment and management of risk associated with groundwater contamination will be carried out using hydro-geological models produced by means of the ModFlow GMS 6.0 software. The assessment of risk posed by mercury contamination will be conducted using the monitoring of mercury pollution level and comparison of the pollution indices with existing state standards and guidelines values.

The proposed study is an applied research in the field of environmental protection. It is assumed that in the course of this works recommendations on management of risks in the Northern industrial area of Pavlodar city including probability to carry out extra works on demercurization of the former PO “Khimprom” and/or brining wastewater storage pond – Lake Balkyldak to safe conditions will be developed and discussed with local stakeholders and state authorities.

### **Obtained results**

Three-year post-demercuration monitoring in the Northern industrial area of Pavlodar city showed expansion of the groundwater mercury contamination beyond the industrial site of PCP to north-north-west direction from the former chlor-alkali production and the former 6<sup>th</sup> wastewater pumping station as it had been predicted by the results of the computer modeling in 2002. At that in spite of absence of risks of both mercury contamination of water supply system in Pavlodarskoe village and mercury ingress to the Irtysh River, there is mercury contamination of the topsoil (more than MPC<sub>s</sub>) and vegetation in sites where mercury-bearing

groundwater can rise up to the original ground. This fact requires continuation of works on creation of cost-effective and efficient technology based on mercury immobilization within the plume of contamination with the view of its experimental use in Pavlodar.

Within the industrial area of PCP decrease of mercury concentration in groundwater is extremely irregular (in the middle part of the plum the mercury concentration dropped very fast down to the safe level, in the plum head it was going down slower than expected) that conformed to the prognosis not very well. This can result from two reasons: (i) dilution of the contaminated groundwater as a result of leaks of clean water from a water supply system, (ii) remaining interaction of the groundwater with sources of the groundwater feeding with mercury despite containment of the main mercury hotspots. So it is necessary to continue works on isolation of mercury hotspots from groundwater, and first of all to remove mercury from contaminated topsoil beyond the perimeter of anti-filtration barrier so called "cut-off wall".

The level of mercury contamination of the topsoil directly at the territory of the industrial site of the former chlor-alkali production remains to be extremely high despite cleanup works conducted. This causes high emission of mercury vapors to the atmosphere (mercury concentration in the near-earth layer in its extreme values exceeded  $10000 \text{ ng/m}^3$ , that is higher than  $\text{MPC}_{\text{wa}}$  for working area) and ingress of soluble mercury forms into groundwater beyond the perimeter of the anti-filtration barrier. Besides persistent high risks to the environment and health of JSC "Kaustik" personnel such a situation does not allow estimating the efficiency of means of mercury hotspots isolation from groundwater. Due to the persistent high risks caused by intensive emission of mercury vapors to the atmosphere it is necessary to create a reliable, durable screen isolating inner perimeter of anti-filtration barrier from the atmosphere apart from removal of topsoil contaminated with mercury. The screen must be engineering structure resistant to both atmospheric precipitation and flood waters similar to covering constructed over the former special ponds for solid and liquid wastes.

Additional data gathered on groundwater mercury pollution and sorption of mercury with bearing strata in the Northern industrial area of Pavlodar city as well as application of modeling system GMS 6.0 software allowed developing the computer model of mercury contamination having divided it into regional model and local one and prepared three-dimensional variant of the model. The new variant of the model allowed prediction of mercury contaminated groundwater rise up to the original ground and formation of new spots of soil mercury contamination that was further proved by results of field tests.

Field and chemical analytical studies allowed developing a vector map of mercury contamination of bottom sediments of the wastewater storage pond Balkyldak and calculating amount of mercury coming to the storage pond together with wastewater (135 336 kg). Biota and possible food chains of the wastewater storage pond Balkyldak were studied. Taking into account considerable decrease of mercury concentration in after-demercurization period both in the pond water (lower than  $\text{MPC}_w$  for natural water) and in fish caught out of the pond (at the level of  $\text{MPC}_{\text{npf}}$  for non predator fish for average values and  $4 \text{ MPC}_{\text{npf}}$  for extreme cases) and respectively decrease of risks to human health, the local authority was recommended, as management of risks posed by this technogenic water body, to confine themselves to their explanatory activity through the mass media such as warning about a danger to use fish from the wastewater storage pond Balkyldak as a foodstuff and also a practice of administrative ban against commercial fishing in the pond Balkyldak. A problem of recovery of mercury-bearing bottom sediments of the wastewater storage pond Balkyldak and their burial should be solved along with consideration and approval of plans of the pond further use.

Keywords: chlor-alkali production, mercury contamination, risk assessment, demercurization, observation boreholes, groundwater, soils, bottom sediments, wastewater storage pond,

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mathematical modeling, groundwater contamination spread, prognoses, maps of mercury contamination, groundwater contamination with oil products