Concept, conditions and problems of realization of "Nura River Clean-up" Project in Kazakhstan

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In the report it is informed that the information regarding realization of the mercury clean-up Project for Nura River and industrial site of the former factory for acetaldehyde production in Central Kazakhstan, initiated by the Government of the Republic of Kazakhstan together with the World Bank and planned for 4 years. Project realization started in 2007 by the Committee for Water Resources of the Ministry of Agriculture of the Republic of Kazakhstan, Contractors from the Chinese People's Republic – "KitayStroy" Ltd and "CGC Overseas Construction Co., LTD Kazakhsan Branch", also by Supervision Engineer - the Austrian company Posch&Partners Consulting Engineers.

Introduction

The source of rise of large mercury biogeochemical anomalies in 1950-1993 near Temirtau in Central Kazakhstan was the production of acetaldehyde. Technological scheme of acetaldehyde production presumed some mercury losses in the form of atomic-dispersed mercury in products; metallic compact, atomic-dispersed, ionic inorganic mercury and mercury organic compounds in wastewater and gas form mercury in ventilation discharges. Mercury discharges into the environment occurred during emergencies, also due to the imperfection of the technology during thermal mercury regeneration from sludge, discharge of mercury containing wastewater into the Nura river (average annual water flow in the river in the section line of Temirtau is about 10 m/s), accumulations of mercury wastes on factory area and beyond its bounds. As a result of it the soil on factory site and around it, river-bed, river banks, and flood-plain got contaminated for 30 km downstream. Area of the former factory for acetaldehyde production due to buildings emergency condition, lack of proper control and means for preventive measures became a potential pesthole of secondary contamination of the environment, rise of emergency situation for people of Temirtau, Karaganda and adjacent regions.

Before to evaluate scope of mercury contamination there were performed the following investigations:

1. During 1997 - 98 within the international project INCO Copernicus the areas of factory site, river banks, flood-plain, and river-bed of the Nura were investigated.
2. In 2001-2002 in order to prepare the draft of Feasibility study for the clean-up of the river basin and factory area the BCEOM company had performed investigations to evaluate localization and thickness of mercury containing ash layers.
3. In 2002- 2003 the Ramboll company carried out investigations of the former sludge trap for mercury containing wastes – the Zhaur swamp.
5. In 2004 to determine a possibility to use historical data during working up of the Feasibility study and evaluation of excavation quantities of the contaminated soil the Posch & Partners company carried out field and laboratory investigations of the river banks, flood-plain, river-bed, and the Zhaur swamp, also the results of previous investigations were analyzed.

Figure 1. General view of the former acetaldehyde production factory.

Tasks and aims of the Project

To improve the ecological situation in Temirtau the Government of the Republic of Kazakhstan together with the World Bank planned and implement the following nature conservation measures designed for 4 years ("Nura River Clean-up" Project):

- construction and operation of the landfill for hazard wastes,
- removal and transportation to the landfill of the mercury contaminated materials, sludge, and soil from the sites related to the industrial site of acetaldehyde production and waste treatment plants,
- clean-up of the river-bed, river banks, and flood-plain: excavation of the contaminated soil and its transportation to the landfill.

The main aims of the Nura River Clean-up Project are:

1. Improvement of living conditions of the people living within the river basin;
2. Removal of the mercury contamination source and provision of safe and inexpensive water supply source which corresponds with the growing needs of water consumers.

Information regarding Project realization process

In 2007 the Contractors from the Chinese People's Republic - "KitayStroy" Ltd and "CGC Overseas Construction Co., LTD Kazakhsan Branch", also Supervision Engineer – the Austrian company Posch&Partners Consulting Engineers, started the Project realization.

During the first two years there was completed a set of works specified in the project.

1. GIS database for the clean-up area was developed. There were carried out works on development of basic cartographic base of GIS-project based on topographic maps, forming of the structure of attribute data bank, insertion of the results of field and analytical works into the attribute data bank, connection of attribute data bank to the GIS-

project and data visualization, geographical binding of historical data, actualization of GIS-project based on new information insertion, modeling of soil mercury contamination spread by layers and calculation of quantities of soil mercury contaminated.

2. The first stage of the monitoring near Tegiz-Zhol village is done. Soil samples were taken from the depth to 3 m from flood-plains and river-banks with various investigation grids.
3. Buildings and structures on the area of acetaldehyde production were dismantled. All the mercury contaminated buildings technologically related to the production process are dismantled to its base.

Figure 2. Drops of metal mercury on the industrial factory site.

4. Excavation and disposal of the contaminated soil from the industrial factory site was done on the landfill. Soil was excavated to 2 m deep based on the data of the previous investigations. Soil disposal was implemented in landfill cells considering hazard class.

Figure 3. Excavation of soil from the base of factory buildings.

5. 1st stage of the landfill construction is done including administrative and auxiliary buildings, laboratory building, cells for disposal of mercury contaminated wastes of the hazard class 1-4, vehicles registration unit, etc.


Figure 4. Landfill panorama.

Figure 5. Containment of the landfill cell base.

6. Sedimentation-ponds of the treatment plants are isolated. Depending on mercury content in sediments there were carried out works on its excavation and containment with further area recultivation.
7. Temporary drain was built; the main drain of Temirtau is cleaned from mercury contaminated sludge and put into operation. Bottom sediments with mercury content higher than then-up criteria were disposed on landfill. Banks of the drain are isolated with clean soil.
8. Pre-excavation investigations by the control grid of the Nura river banks and flood-plain are implemented. Investigations were carried out by regular grid with sampling to 3 m deep and 20 cm interval. Contamination maps with marked detailed investigations are built.
9. Mercury reduction plant is constructed. However, the plant was not put into operation due to a number of technical imperfections.
10. The contaminated sections of the ash-dump are investigated, removed, and isolated. Ash-dump sections with mercury content more than 1500mg/kg were removed and disposed on landfill. Less contaminated sections were covered with clean soil layer.
11. The first transfer station for re-loading of mercury contaminated soil was built, it is located near the road close to the Zhaur swamp and it is provided with a unit for vehicles registration, weighbridge, areas for temporary stockpiling of contaminated soil prior its delivery to the landfill.
12. Excavation and disposal of contaminated soil from the Zhaur swamp are started. After the determination of sections with mercury content more than 10 mg/kg and 1500 mg/kg the contaminated soils were removed and delivered to the landfill cells for the hazard class 1 and 2-4.
13. Monitoring of environment objects is being carried out. Mercury vapors content is measured on factory site, in inhabited localities, landfill, on transfer stations, and on work sites taking into account “wind rose”, meteorological parameters of the environment.

For 2009 the following work types are planned:

1. Maintenance and updating of GIS database;

2. Second stage of monitoring near Tegiz-Zhol village;
3. Evaluation of clean-up success of Zhaur swamp, factory site and area recultivation;
4. Detailed pre-excavation investigations of river-banks, flood-plain, and river-bed;
5. Completion of works for containment of sedimentation ponds of treatment plants and/or excavation of sediments;
6. Setting-up, test and put into operation of mercury reduction plant;
7. Completion of landfill construction;
8. Excavation and disposal of the contaminated soil and sediments of the river banks and river-bed;
9. Continuation of monitoring of environment objects.

Complicating factors of Project realization

Main complicating factors during works are the difficult climate conditions and lack of qualified specialists at Contractors. The project area is located in Central Kazakhstan and is characterized with sharp continental and dry climate. Spring starts in the end of March, winter starts in November. The region is characterized with constant windy weather. Soil freezing depth depends on air temperature and thickness of snow cover and varies within 1.3-1.5 m. The deepest of soil freezing reaches 3.5 m. Because of it during autumn-winter period works are complicated with climate conditions.

Works carried out by the project include not only construction-assembling works but also ecological investigations (pre-excavation investigations, evaluation of clean-up success, analytical measurements, monitoring over environment condition, etc.). Contractors' staff is basically represented by specialists of construction, topographical-geodetic and earthworks. Lack of sufficient number of specialists of environment engineering at Contractor's staff complicates works implementation at a proper level.

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