

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”

Final Project Activity Report

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

Non-profit JSC “Almaty Institute of Power Engineering and Telecommunication”
Almaty, 050013, 126 Baytursynov str., Kazakhstan

Project Manager Mikhail Alexeevich
 Ilyushchenko
 PhD



31.08.2011

Signature / Date

1. Objectives of the Project, Scope of Work and Technical Approach

1.1. The objectives of the research

I. to identify the risk associated with the spread of groundwater plumes contaminated with mercury and oil derivatives, including their movement through the network of water intake boreholes in village Pavlodarskoye, and further towards river Irtysh and/or their rise onto the pastures and, if significant, identify a management strategy to contain risk;

II. to identify a management strategy for containing the environmental risk, caused by the mercury pollution of lake Balkyldak, including the pathway of pollutants bioaccumulation via food chains;

1.2. Expected Results

The proposed study is an applied research in the field of environmental protection. It is assumed that in the course of this work new facts might be revealed that would require the deepening and the extension of the research. The results of the research and its stages will be presented as interim and final reports.

- One of the most important results of proposed study will be the foundation of monitoring laboratory of PCP that will be capable to implement Post-containment monitoring Program in Northern industrial area of Pavlodar during 2005-2020 after completion of proposed ISTC study. This laboratory will be also capable to conduct other investigations in the field of environmental protection. The completion of Phase I of Demercurization Project does not assume termination of the investigation of mercury pollution in Pavlodar. The Phases II & III are starting that will require more detailed and more extensive studies of the residual mercury pollution and associated risk. These reasons will allow the laboratory of PCP to become self-supporting;
- PCP together with AUPET will carry out the monitoring study of the mercury contamination of groundwater in the Northern industrial area of Pavlodar;
- AUPET together with PCP will study the extent mercury contamination of pastures in the areas where the upward movement of polluted groundwater is possible;
- BMP together with PCP will conduct the monitoring study regarding to the groundwater contamination with petroleum and oil derivatives in Northern industrial area of Pavlodar;
- AUPET together with PSU will determine the levels of total mercury content in bottom sediments and biota from wastewater storage pond – lake Balkyldak;
- AUPET together with IHH will assess the risks associated with the residual mercury contamination of groundwater and wastewater storage pond – lake Balkyldak;
- IHH together with AUPET will assess the risks posed by contamination of groundwater with oil and petroleum derivatives;
- IHH will upgrade the groundwater model for the Northern industrial area of Pavlodar and make it more accurate. IHH will make forecasts for the future spread of groundwater contaminated with Hg and oil products;
- AUPET together with IHH will draw up and discuss with local stakeholders and state authorities the proposal for risk management in Northern outskirts of Pavlodar including possible implementation of 2nd stage of PO “Khimprom” demercurizing and/or brining wastewater storage pond – lake Balkyldak to safe conditions.

1.3. Technical Approach

During sampling and chemical analyses the 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 will be carried out using AAS analyzer (Lumex RA 915+); AFS analyzer (PS Analytical Millennium Merlin System) will be used for Hg determination in water samples and biological tissues. Chemical analysis of oil products' concentration in water will be conducted using CG Perkin Elmer Clarus 500.

Assessment and management of risk associated with groundwater contamination will be carried out using hydrogeological models received by means of the ModFlow GMS 5.0 software. The preliminary assessment of risk (Tier 1 of risk assessment) posed by mercury contamination of pastures and fish will be conducted using the monitoring of the level of mercury pollution and subsequent comparison of pollution indices with existing state standards and guidelines values.

2. Summary of Project Progress

2.1. Tasks of the Work Plan

Task Subtask	Start (quarter)	End (quarter)	Technical Status / Comments
1.1.	2	17	Completed
1.2.	5	8	Completed
1.3.	1	15	Completed
2.1.	1	2	Completed
2.2.	3	4	Completed
2.3.	5	6	Completed
2.4.	7	10	Completed
2.5.	11	11	Completed
2.6.			Replaced with other works within Subtask 1.3 in 14-15 quarters
2.7.			Replaced with other works within Subtask 1.3 in 14-15 quarters
2.8.			Replaced with other works within Subtask 1.3 in 14-15 quarters
2.9.	8	8	Completed
3.1.	2	17	Completed
3.2.	10	12	Completed
3.3.			Replaced with other works within Subtask 1.3 in 14-15 quarters
3.4.	4	12	Completed
3.5.	12	15	Completed
3.6.	15	15	Completed
4.1.	1	2	Completed
4.2.	2	8	Completed
4.3.	3	10	Completed
4.4.	3	8	Completed
4.5.	4	11	Completed
4.6.	11	16	Completed
5.1.	1	17	Completed
5.2.	1	16	Completed

2.2. Project fulfillment

Task 1: Study of the movement of mercury in the groundwater rise in depressed area in saturated and unsaturated zones and its accumulation in the shallow ponds and vegetation. Development of management strategy to contain the risk to population in the vicinity and livestock.

Subtask 1.1: To facilitate the Laboratory of environmental protection of PCP with the equipment for conduction of mercury monitoring, and to train the local staff.

The equipment for mercury monitoring procurement of which was one of the main tasks of the project had to be purchased from the budget of the Participant Institution PCP. However its purchase was not done within the original duration of the project due to the bankruptcy of Pavlodar Chemical Plant and conducting the procedure of the Participant Institution replacement by JSC “Kaustik” (which has become a new owner of the industrial area of PCP and kept in general its staff). The replacement procedure was started in 4th quarter and completed only in 11th quarter through Mihail Valentine, the first curator of ISTC K-1240p project fault.

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The new list of laboratory equipment necessary to purchase for the Nature Protection Laboratory of JSC “Kaustik” was discussed and approved by Eun Joo Yi, the second project curator and Paul Randall, the project coordinator during their visit to Pavlodar in September, 2008. In 14th quarter the Request for procurement of laboratory equipment and materials for Participant Institution JSC “Kaustik” was prepared and sent to ISTC, which was completely implemented only due to insistent pressure of Patrick Russo, the third curator of ISTC K-1240p project. All laboratory equipment delivered to AUPET in 17th quarter and after the project completion was unpacked, checked for being complete, tested if necessary, and dispatched to Pavlodar city to the Participant Institution JSC “Kaustik”.

Training of JSC “Kaustik” personnel in the equipment operation was conducted by AUPET during field works on ISTC K-1477p project (AUPET and JSC “Kaustik” were both Participant Institutions of this project too) which was completed in April 2011. Field and chemical-analytical works on K-1240p project related to the project tasks 1, 2 and 4 were implemented using equipment belonging to field and stationary laboratories of Participant Institution AUPET.

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▪ **Personnel Commitments**

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	38
Kuz'menko Larisa V.	AUPET	1	144
Mukhamedzhanov Khamit V.	AUPET	2	20
Uskov Grigoriy A.	AUPET	2	42
Yakovleva Lyudmila V.	AUPET	2	10
Stepanov Vladimir A.	AUPET	3	60
Akhmetov Artur D.	Kaustik	1	48
Merenkova Ludmila B.	Kaustik	1	29
Soloveva Nadezhda V.	Kaustik	1	33

Subtask 1.2: To revise the Program of Post-containment Monitoring by expanding the study of pollution of groundwater and biota, and by adding the tests of grazing grass and milk.

Activity on post-demercuration monitoring was intended to conduct according to the Program developed by AUPET in 2004, which was expected to cover the period from 2005 to 2020. The Program was developed on demand of Pavlodar Oblast Environmental Protection Department. The monitoring works were expected to be implemented generally by the Nature Protection Laboratory of PCP with the help of the equipment purchased on ISTC K-1240p project. However because of delay with the equipment delivery (see Subtask 1.1) JSC “Kaustik” could not participate in tenders for works on the Program of post-demercuration monitoring, which were held by Pavlodar oblast Akimat every year. Such a monitoring was carried out by casual small companies which used results including those obtained by AUPET on ISTC K-1240p project. They also corrected the Program of post-demercuration monitoring to adjust it to capabilities of their field and laboratory equipment.

At the same time after conducting summer and autumn field works in 2006 it became evident the necessity to broaden the work program on K-1240p project itself in terms of increase in scope of mercury monitoring of soils and producing an additional map of soils mercury contamination in the Northern industrial area of Pavlodar city as well as to include there investigation of both the atmosphere pollution with mercury vapors and groundwater - with methyl mercury. The K-1240p project Work Plan correction lay mainly in broadening Subtask 1.3 at the cost of giving the Subtasks 2.6-2.8 (drilling additional boreholes) up and contraction of Subtasks 3.3 and 3.4 (oil products monitoring) that also related to impossibility to drill new boreholes. Drilling works had to be paid from Participant Institution PCP budget, but it was impossible to do because of the procedure of Participant Institution PCP replacement by JSC “Kaustik” (see Subtask 1.1).

To produce the new map of soils contamination in 2008 (VIII quarter) a Soil Sampling Plan was developed for three upper soil layers (0-10, 10-20, 20-50 cm) on a regular grid with different steps. New Soil Sampling Plan was delivered to Participant Institution JSC “Kaustik” for conducting field works within K-1240p project as well as for preparation of the II Phase of the Program of demercurization at the cost of new financing sources.

▪ Personnel Commitments

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	22
Aksenova Tatiana V.	AUPET	1	30
Kiseleva Raisa A.	AUPET	1	30
Primbetova Galina I.	AUPET	1	30
Sharov Boris A.	AUPET	1	30
Shevchenko Natal'ya N.	AUPET	1	30
Kuz'menko Larisa V.	AUPET	1	66
Kamberov Rustam I.	AUPET	2	29
Mikhaylenko Natal'ya A.	AUPET	2	30
Mukhamedzhanov Khamit V.	AUPET	2	20
Yakovleva Lyudmila V.	AUPET	2	79
Ibraeva Alma A.	AUPET	3	60
Panichkin Vladimir Y.	IHH	2	16
Akhmetov Artur D.	Kaustik	1	25

Subtask 1.3: To carry out 3-year monitoring program (sampling and analysis), including the monitoring of soils, surface and ground water, aquatic biota, milk, and grazing grass in the close vicinity of groundwater contamination. To measure the hydrogeological parameters (water levels in boreholes, pH, temperature, redox potential) simultaneously with groundwater sampling.

Post-demercuration monitoring was being conducted for three field seasons in 2006-2008, which involved field and chemical-analytical investigations.

Field works of 2006:

1.3.1. Groundwater survey: in June-July of 2006 groundwater samples were taken from 87 hydrogeological observation boreholes for total mercury determination, and also from 2 observation boreholes for methyl mercury determination; twice in July and September of 2006 groundwater tables were measured in 239 observation hydro-geological boreholes (“Summsry tables 02. and 03.2006”).

1.3.2. Soil Sampling Plan has been produced on a regular grid at five places of mercury contaminated groundwater possible wedging out at the territory between the 1st industrial area of Pavlodar Chemical Plant and Lake Balkyldak.

1.3.3. Soil sampling: in July, 2006 19 topsoil (0-10 cm) samples were taken at the industrial area of former chlor-alkali production; in September, 2006 111 topsoil samples were taken on regular grid from

5 places of mercury contaminated groundwater possible wedging out at the territory between the industrial area #1 and wastewater storage pond – Lake Balkyldak for their analyses for total mercury.

1.3.4. Measurement of mercury vapor concentration in the near-earth air (0-10 cm): 20 measurements were done at the industrial area of former chlor-alkali production on the 21st of July, 2006 since 3 pm till 6 pm at the air temperature of 27° C (“Summary table 07.2006”).

1.3.5. Electronic summary tables (“Summary tables 02 - 07.2006”), which formed the database of post-demercuration monitoring in site of the industrial area of former JSC “Khimprom”, Pavlodar have been compiled on the results of field study and chemical analytical works.

1.3.6. The results of determination of mercury concentration in groundwater at the area of mercury pollution (“Summary table 05.2006) have been inserted on the vector map together with the results of similar research of 2004 and 2005.

Field works of 2007:

1.3.7 Groundwater survey: in September-October of 2007 groundwater samples were taken from 81 hydro-geological observation boreholes for total mercury determination, at the same time groundwater tables were measured in 154 observation boreholes.

1.3.8. 4 integral samples of gramma grass were taken within the area which was used as a pasture for livestock by population of Pavlodarskoe village.

1.3.9. Computer “Summary tables of 01 - 03.2007” were compiled on the results of field study and chemical analytical works.

1.3.10. The map of soil mercury contamination produced in 2002 was made to be more accurate based on the results of determination of mercury concentrations in soil.

1.3.11. The results of determination (2007) of mercury concentration in groundwater at the area of mercury pollution (“Summary table 02.2007) were inserted on the vector map together with the results of similar research of 2004, 2005 and 2006

Field works of 2008:

1.3.12. Groundwater survey: in August-September of 2008 groundwater samples were taken from 74 hydro-geological observation boreholes for total mercury determination, at the same time groundwater tables were measured in 150 observation hydro-geological boreholes (“Summary table 01.2008”).

1.3.13. Surface water survey: in August of 2008 10 water samples were taken from the wastewater storage pond – Lake Balkyldak using membrane filters with pores’ diameter of 0.45 µm for separate determination of dissolved and total mercury (“Summary table 03.2006”).

1.3.14. Soil sampling: in September-October of 2008 240 topsoil (0 -10 cm) samples were taken on the regular grid for total mercury analysis within the area of demercuration at the territory of the former PO “Khimprom”, Pavlodar. When taken soil samples were homogenized and divided into duplicates: one duplicate was sent to Stepnogorsk Laboratory of Biomonitoring of Participant Institution BMP; another one - to AUPET Laboratory in Almaty (where chemical analytical works were fulfilled in 2009).

1.3.15. Electronic summary tables (“Summary tables 01 - 04.2008”) were compiled on the results of field study and chemical analytical works.

1.3.16. The results of determination of mercury concentration in soils were used for producing a new map of soil mercury contamination in the area of demercuration (2008).

1.3.17. The results of determination of mercury concentration in groundwater at the area of mercury pollution of 2008 (“Summary table 02.2008”) were compiled in the Table of results of determination of total mercury on wells PCP in 2004- together with the results of similar research of 2004, 2005, 2006 and 2007and 2008 inserted on the vector map.

Chemical analytical works with samples taken in 2006-2009:

1.3.18. Analyses of groundwater samples for total mercury of 2006-2007 were carried out in the laboratory building provided by JSC “Kaustik” at the territory of former PO “Khimprom”, Pavlodar using chemical analytical equipment brought from Almaty and those of 2008 – in the stationary laboratory of AUPET in Almaty. In total about 800 samples of surface and underground waters have been analyzed including blanks and replicas (“Summary tables 05.2006, 02.2007, 02 и 03.2008”).

1.3.19. Analyses of 3 groundwater samples for methyl mercury content were conducted in an analytical laboratory of Department of Environmental Sciences, Jožef Stefan Institute, Ljubljana, Slovenia (“Summary table 04.2006”).

1.3.20. Analysis of soil samples was carried out in the stationary laboratory of AUPET in Almaty in 2007 and 2009 (in total 370 samples) and in Stepnogorsk Laboratory of Biomonitoring of Participant Institution BMP in 2009 (in total 240 samples) (“Summary tables 06.2006 и 04.2008”), 4 samples of gramma grass – in the stationary laboratory of AUPET in Almaty (“Summary table 03.2007”).

After the monitoring completion risks in the Northern industrial area of Pavlodar coming from remaining soil and groundwater contamination with mercury as well as possible technical solutions on soil and groundwater remediation at the site of the former chlorine production were discussed with experts.

▪ Personnel Commitments

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	65
Aksenova Tatiana V.	AUPET	1	30
Kiseleva Raisa A.	AUPET	1	30
Primbetova Galina I.	AUPET	1	30
Sharov Boris A.	AUPET	1	30
Shevchenko Natal'ya N.	AUPET	1	30
Kuz'menko Larisa V.	AUPET	1	38
Galushchak Sergey S.	AUPET	2	18
Kamberov Rustam I.	AUPET	2	129
Mikhaylenko Natal'ya A.	AUPET	2	46
Mukhamedzhanov Khamit V.	AUPET	2	68
Uskov Grigoriy A.	AUPET	2	222
Yakovleva Lyudmila V.	AUPET	2	77
Zyryanova Nataliya A.	AUPET	2	157
Stepanov Vladimir A.	AUPET	3	198
Galieva Elena V.	BMP	1	15
Kirplyuk Eduard V.	BMP	1	4
Prikhodko Tatyana V.	BMP	1	29
Smirnova Svetlana Y.	BMP	1	19
Starodubova Valentina F.	BMP	1	20
Abel'denov Saylau K.	BMP	2	24
Balpanov Darkhan S.	BMP	2	20
Mukanov Kasym K.	BMP	2	16
Volkov Oleg E.	BMP	2	54
Zhulikova Xsenia S.	BMP	2	24
Akhmetov Artur D.	Kaustik	1	70
Karimov Sharapat S.	Kaustik	1	81
Kosyashnikova Ol'ga M.	Kaustik	1	57
Merenkova Ludmila B.	Kaustik	1	30
Putikova Lyudmila Y.	Kaustik	1	49
Sedletskaya Natal'ya I.	Kaustik	1	24
Shelkopyas Lidiya V.	Kaustik	1	19
Soloveva Nadezhda V.	Kaustik	1	44
Tskay Alexandra I.	Kaustik	1	10

Task 2: Assessment of possibility for mercury-polluted groundwater flow to change its direction; study of interaction of contaminated groundwater with bearing strata and underlying aquifers
Subtask 2.1: To convert the model of groundwater of Northern industrial area of Pavlodar into updated version of ModFlow GMS 6.0 software.

GMS 6.0 simulation system was purchased, its characteristics and potential to simulate mercury transport by groundwater were studied. The regional model of hydro-geological conditions of the Northern industrial area of Pavlodar was converted into upgraded version of GMS 6.0 software.

▪ Personnel Commitments

Name	Institute	Category	Days
Miroshnichenko Oxana L.	IHH	2	20
Panichkin Vladimir Y.	IHH	2	20
Trushel' Lyudmila Y.	IHH	2	24
Zakharova Nonna M.	IHH	2	22

Subtask 2.2: To enter into the model the additional data characterizing the hydrogeological structure of eastern border of river Irtysh valley will be entered to the model.

First stage of calibration of the hydrodynamic model of groundwater at the area of former PO "Khimprom", Pavlodar was carried out. Inverse stationary task was solved. Position of groundwater table as of 1970 i.e. conditionally undisturbed period was reproduced in the model. Filtration coefficients of water bearing strata and a value of groundwater infiltration recharge were made more precise.

▪ Personnel Commitments

Ф.И.О.	Институт	Категория	Кол-во дней
Kamberov Rustam I.	AUPET	2	27
Mikhaylenko Natal'ya A.	AUPET	2	30
Mukhamedzhanov Khamit V.	AUPET	2	6
Miroshnichenko Oxana L.	IHH	2	20
Panichkin Vladimir Y.	IHH	2	20
Trushel' Lyudmila Y.	IHH	2	8
Zakharova Nonna M.	IHH	2	7

Subtask 2.3: To create the detailed "incut" model for the area of Hg contaminated groundwater. Project Management

Calibration of the local model of hydro-geological conditions at the area of groundwater mercury contamination was completed. Three-dimensional demonstration variant of the model was made.

▪ Personnel Commitments

Name	Institute	Category	Days
Iyushchenko Mikhail A.	AUPET	1	4
Miroshnichenko Oxana L.	IHH	2	158
Panichkin Vladimir Y.	IHH	2	160
Trushel' Lyudmila Y.	IHH	2	54
Zakharova Nonna M.	IHH	2	56

Subtask 2.4: To make detailed forecasts for mercury pollution spread taking into account the parameters of adsorption/desorption equilibrium.

To assess the risk of the soil mercury contamination as a result of the contaminated groundwater rise to the ground surface followed by their evaporation analysis of characteristics of hydro-geological conditions at the investigated area as well as the results of the modeling was carried out with a view to

reveal spots with high possibility for mercury there to get to zone of aeration. Prognosis of the plume of groundwater mercury contamination spread for 30 years was made. The result was obtained showing high risk of formation of new hotspots of mercury contamination of soil at the territory between the industrial site #1 and the wastewater storage pond Balkyldak.

▪ **Personnel Commitments**

Name	Institute	Category	Days
Miroshnichenko Oxana L.	IHH	2	137
Panichkin Vladimir Y.	IHH	2	114
Trushel' Lyudmila Y.	IHH	2	38
Zakharova Nonna M.	IHH	2	42

Subtask 2.5: To assess the risk posed by mercury pollution for the network of operating boreholes in Pavlodarskoye village and river Irtysh floodplain.

Coincidence of the results of groundwater post-demercurization monitoring (2005-2007) with the prognosis of the plum of groundwater mercury contamination spread for 30 years was estimated. Spread of groundwater mercury contamination to the west reaching the boreholes 73-02 and 79-02 was shown to result from both continuation of the plume of contamination movement in the north-north-west direction and widening in its middle part in accordance with the prognosis. Such direction of the contaminated groundwater movement poses no threat of mercury pollution to both the Irtysh River and water-supply wells of Pavlodarskoye village. In case of unchangeable hydro-geological conditions the risk of similar course of events is absent. Unfavorable change of hydro-geological conditions can be caused only by some technogenic reasons.

At the same time comparison of the prognosis and factual data as well as their analysis has shown that at present there is no predicted shrinking of the area of the contamination spread as a result of construction of the anti-filtration barrier, so called cut-off wall at the industrial site of the former chlorine production. Decrease in mercury concentration in the boreholes P-8, 86-02 and B-13 is supposed to result from flanking intrusion of non contaminated water into the plum of contamination due to leak from the plant water-supply network.

There is no any threat of mercury pollution to both the Irtysh River and water-supply wells of Pavlodarskoye village in the nearest 30 years. At the same time it is impossible to estimate effectiveness of containment of the main source of mercury contamination at the place of the demolished workshop No.31 because of ingress of soluble mercury compounds to the groundwater from the mercury contaminated topsoil around the industrial site of the former chlorine production.

▪ **Personnel Commitments**

Name	Institute	Category	Days
Kuz'menko Larisa V.	AUPET	1	23
Miroshnichenko Oxana L.	IHH	2	40
Panichkin Vladimir Y.	IHH	2	40
Trushel' Lyudmila Y.	IHH	2	16
Zakharova Nonna M.	IHH	2	14

Subtask 2.6: To construct additional observation boreholes reaching the second aquifer in the area of mercury pollution

The work can not be implemented due to absence of funds in a budget of Participant Institution PCP (see the subtask 1.1). It was replaced by field and chemical analytical works fulfilled in 2008 – 2009 according to an expanded program of the subtask 1.3 (see sections 1.3.14, 1.3.16 and 1.3.20).

- **Personnel Commitments**

Subtask 2.7: To take samples of bearing strata during drilling of additional boreholes and samples of groundwater after drilling for subsequent laboratory experiments.

The work can not be implemented due to absence of funds in a budget of Participant Institution PCP (see the subtask 1.1). It was replaced by field and chemical analytical works fulfilled in 2008 – 2009 according to an expanded program of the subtask 1.3 (see sections 1.3.14, 1.3.16 and 1.3.20).

- **Personnel Commitments**

Subtask 2.8: To analyze the samples of groundwater for the concentration of total Hg and major anions.

The work can not be implemented due to absence of funds in a budget of Participant Institution PCP (see the subtask 1.1). It was replaced by field and chemical analytical works fulfilled in 2008 – 2009 according to an expanded program of the subtask 1.3 (see sections 1.3.14, 1.3.16 and 1.3.20).

- **Personnel Commitment**

Subtask 2.9: To conduct laboratory study of adsorption equilibrium in the system bearing strata – solution of Hg (II) nitrate and Hg (II) chloride; to perform the leaching tests for adsorbed mercury.

In AUPET stationary laboratory solutions of mercury (II) chloride of different concentration were added to soil samples not containing mercury and taken when drilling observation boreholes in 2002. The mixtures were shaken automatically for 6 hours in isothermal conditions at 15°C and natural pH. After attaining equilibrium the solutions were filtered through membrane filters and analyzed for total mercury. Using the obtained results Freundlich and Henry adsorption isotherms were constructed and adsorption coefficients were calculated.

Averaged coefficients of adsorption isotherms were delivered to IHH to use them for simulation of hydro-geological processes of the mercury contamination spread.

- **Personnel Commitments**

Name	Institute	Category	Days
Uskov Grigoriy A.	AUPET	2	15
Yakovleva Lyudmila V.	AUPET	2	5
Zyryanova Nataliya A.	AUPET	2	5

Task 3 (new variant): Creation of a map of soils mercury contamination in Northern industrial area of Pavlodar with a view to develop a feasibility study of their clean up:

Subtask 3.1. (new variant): To draw a sampling plan of the soils from the layers 0-10, 10-20, 20-50 deep according to a regular grid for the industrial area #1 of the former PO “Khimprom”, Pavlodar and in the vicinity. The regular grid should be more detailed in heavily contaminated places in compliance with the map of soils mercury contamination as of 2001 as well as with the results of the soils monitoring conducted on the Task 1.

(See the subtask 1.1). Field and chemical analytical works on ISTC K-1240p related to the task 3 were carried out using equipment belonging to field and stationary laboratories of Participant Institution BMP.

- **Personnel Commitments**

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	29

Kuz'menko Larisa V.	AUPET	1	15
Kamberov Rustam I.	AUPET	2	51
Uskov Grigoriy A.	AUPET	2	20
Yakovleva Lyudmila V.	AUPET	2	27
Zyryanova Nataliya A.	AUPET	2	27
Stepanov Vladimir A.	AUPET	3	9
Kirplyuk Eduard V.	BMP	1	12
Kolysheva Ol'ga I.	BMP	1	8
Kosinov Aleksandr N.	BMP	1	8
Ponomarenko Aleksandr S.	BMP	1	8
Prikhodko Tatyana V.	BMP	1	16
Smirnova Svetlana Y.	BMP	1	16
Starodubova Valentina F.	BMP	1	11
Abel'denov Saylau K.	BMP	2	9
Balpanov Darkhan S.	BMP	2	5
Mukanov Kasym K.	BMP	2	8
Volkov Oleg E.	BMP	2	16
Zhulikova Xsenia S.	BMP	2	8
Bazarbekov Kairbay U.	PSU	2	6
Kalieva Aida A.	PSU	2	28
Akhmetov Artur D.	Kaustik	1	29.5

Subtask 3.2: Basing on the hydro-geological model of Northern industrial area of Pavlodar to estimate the most likely direction of the plume of oil products with groundwater

Based on the analysis of archival data and the general model of the Northern industrial area of Pavlodar a maps of level surface within the industrial area of Pavlodar Oil Refinery (POR) for the period of 1987–2007 was produced.

Possible direction of spread of the plume of oil products groundwater pollution from the underground contaminating spot of oil products at the territory of Pavlodar Oil Refinery was estimated.

▪ Personnel Commitments

Name	Institute	Category	Days
Kirplyuk Eduard V.	BMP	1	12
Kolysheva Ol'ga I.	BMP	1	12
Prikhodko Tatyana V.	BMP	1	8
Smirnova Svetlana Y.	BMP	1	16
Starodubova Valentina F.	BMP	1	8
Abel'denov Saylau K.	BMP	2	6
Balpanov Darkhan S.	BMP	2	6
Mukanov Kasym K.	BMP	2	9
Volkov Oleg E.	BMP	2	16
Zhulikova Xsenia S.	BMP	2	8
Miroshnichenko Oxana L.	IHH	2	40
Panichkin Vladimir Y.	IHH	2	40
Trushel' Lyudmila Y.	IHH	2	20
Zakharova Nonna M.	IHH	2	19
Akhmetov Artur D.	Kaustik	1	4
Karimov Sharapat S.	Kaustik	1	20
Kosyashnikova Ol'ga M.	Kaustik	1	16
Merenkova Ludmila B.	Kaustik	1	26
Sedletsкая Natal'ya I.	Kaustik	1	26
Shelkopyas Lidiya V.	Kaustik	1	30

Tskay Alexandra I.	Kaustik	1	30
Yepifantseva Tatiana M.	Kaustik	1	30

Subtask 3.3: To construct the cross-section of boreholes at right angle to plume direction at the distance of 1-1.5 km from pollution source in order to detect the plume of contamination. To use concurrent drilling of new boreholes and sampling & chemical analysis of groundwater

The work can not be implemented due to absence of funds in a budget of Participant Institution PCP (see the subtask 1.1). It was replaced by field and chemical analytical works fulfilled in 2008 – 2009 according to an expanded program of the subtask 1.3 (see sections 1.3.14, 1.3.16 and 1.3.20).

▪ **Personnel Commitments**

Subtask 3.4: To contour the plume by creation of the network of observation boreholes in the plume direction. To use concurrent drilling of new boreholes and sampling & chemical analysis of groundwater

Depth of occurrence of upper boundary of underground waste oil sump and its spread to the west direction were investigated in the vicinity of the fence around the industrial area of Pavlodar Oil Refinery 500 m far from its north-west corner. For that using a hand-held soil auger four boreholes 5.5 m deep were drilled at 10 m interval along the profile of sub-latitudinal strike. When drilling the first and the second boreholes starting from the depth of 2.6 m from the ground surface strong smell of oil products appeared what the evidence of the pollution was. At that the maximum high groundwater table for this site was recorded as 4.8 m. In the third and fourth boreholes the oil products were not found. Thus the oil sump not less than 2 m thick has spread 25-30 m far to the west from the industrial area of Pavlodar Oil Refinery.

Since it turned out impossible to fulfill drilling of new boreholes at the area of oil products groundwater contamination (see the subtask 3.3) in August-September, 2008 AUPET team took groundwater samples from 80 accessible boreholes belonging to the existing network of observation boreholes of the Northern industrial area of Pavlodar. Been cooled the groundwater samples were sent to Participant Institution BMP to Stepnogorsk Laboratory of Biomonitoring where during a week the samples were analyzed for recoverable petroleum carbohydrates using the gas chromatographer "Hewlett Packard", USA with flame-inductive detector. In none of the groundwater samples taken at the Northern industrial area of Pavlodar the oil products dissolved in water were found.

▪ **Personnel Commitments**

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	6
Kuz'menko Larisa V.	AUPET	1	15
Kamberov Rustam I.	AUPET	2	18
Uskov Grigoriy A.	AUPET	2	22
Zyryanova Nataliya A.	AUPET	2	17
Stepanov Vladimir A.	AUPET	3	14
Prihodko Tatyana V.	BMP	1	22
Smirnova Svetlana Y.	BMP	1	19
Starodubova Valentina F.	BMP	1	16
Abel'denov Saylau K.	BMP	2	11
Balpanov Darkhan S.	BMP	2	7
Mukanov Kasym K.	BMP	2	11
Volkov Oleg E.	BMP	2	12
Zhulikova Xsenia S.	BMP	2	11

Subtask 3.5: To draw up the forecasts for the spread of oil products with groundwater using the hydrogeological model in the Northern industrial area of Pavlodar

The archival data analysis was conducted. The boundaries of the local model of the area of oil products contamination were chosen. Detailed hydro-geological cross-sections of the modeled area were constructed. Hydro-geological conditions were schematized (number of layers of the local model was determined, their boundaries were drawn at the hydro-geological cross-sections, internal and external boundary conditions were established for the local model etc.). The cross-sections and the results of schematization were introduced in Geographic Information System (GIS) produced by means of MapInfo software as well as in the data base produced by means of FoxPro software. Using MapInfo software the hydro-dynamic scheme was constructed. The results of schematization were transformed into formats used by GMS 6.0 modeling system.

Based on the regional model of groundwater of the Northern industrial area of Pavlodar a hydro-dynamic model was produced for the area of possible spread of groundwater contaminated with oil products between Pavlodar Oil Refinery and Pavlodarskoe village, epignosis and prognosis tasks were solved, change of level surface was analyzed.

Large-scale hydro-dynamic model of the area of groundwater pollution with oil products was created based on gathered archive data with the help of GMS 6.0 software, which simulates groundwater flow movement under effect of natural and technogenic factors.

Hydro-geological conditions for thirty-year period were predicted with the help of MODFLOW module. Then using ModPath module the trajectories of movement of oil products dissolved in groundwater were calculated.

▪ Personnel Commitments

Name	Institute	Category	Days
Kamberov Rustam I.	AUPET	2	45
Miroshnichenko Oxana L.	IHH	2	59
Panichkin Vladimir Y.	IHH	2	55
Trushel' Lyudmila Y.	IHH	2	10
Zakharova Nonna M.	IHH	2	10

Subtask 3.6: To assess the risks posed by groundwater contamination with oil products for the population of Northern outskirts of Pavlodar and for river Irtysh floodplain

The trajectory calculated using ModPath module goes from Pavlodar Oil Refinery towards the Irtysh River in fact through the centre of Pavlodarskoe village. The results of the modeling proved high probability of oil products ingress into waster supply wells of Pavlodarskoe village what means high potential risks for health of its inhabitants.

▪ Personnel Commitments

Name	Institute	Category	Days
Kamberov Rustam I.	AUPET	2	5
Miroshnichenko Oxana L.	IHH	2	10
Panichkin Vladimir Y.	IHH	2	10

Task 4: Assessment of possibility to contain the risk posed by mercury pollution of lake

Balkyldak including the fish within it:

Subtask 4.1: To create the vector map of lake Balkyldak and to design two versions of sampling plan (for summer and winter sampling). To assess the performance of each sampling option and to select the optimal solution.

According to archive documents relating to the design of the wastewater storage pond - Lake Balkyldak creation the following was prepared: (i) preliminary computer map for a plan of bottom sediment sampling and (ii) bathymetry plan of the wastewater storage pond.

Preliminary investigation of Lake Balkyldak in winter time and discussion of the problem with local experts suggested necessity to develop combined winter-summer plan of bottom sediment sampling on Lake Balkyldak. Ice depth at the storage pond is 70-150 cm depending on winter severity. In any case such depth is sufficient to do safe bottom sediment sampling from under the ice in March when strong frosts are no longer there but snow melting does not start yet. Possibility to take samples near the shore depends on ice depth and freezing through the bottom at the shallow depth. In points where water column was frozen entirely to the bottom, samples of bottom sediments were taken from the rubber boat in summer time.

▪ Personnel Commitments

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	27
Kamberov Rustam I.	AUPET	2	12
Mukhamedzhanov Khamit V.	AUPET	2	6
Uskov Grigoriy A.	AUPET	2	20.5
Yakovleva Lyudmila V.	AUPET	2	17
Zyryanova Nataliya A.	AUPET	2	18
Miroshnichenko Oxana L.	IHH	2	40
Panichkin Vladimir Y.	IHH	2	40
Kuz'min Valeriy S.	PSU	1	25
Mal'kov Igor' V.	PSU	1	11
Pastukh Viktor P.	PSU	1	50

Subtask 4.2: To sample the bottom sediments from lake Balkyldak by regular grid using the different types of samplers and augers.

Field works of 2006:

4.2.1. Four variants of the pond Balkyldak bottom sediment Sampling Plan on the regular grid for 200, 150, 100 and 50 sampling points were produced in order to choose the most optimal one depending on complexity of the field works and terms of their fulfillment.

4.2.2. Bottom sediments sampling and measurement of soft sediment thickness in the wastewater storage pond – Lake Balkyldak: in February, 2006 107 bottom sediment samples were taken from under the ice in 52 sampling points and in July, 2006 33 samples - from the boat board in 17 sampling points. Measurements of the sediment depth and thickness were done on 69 sampling points (“Summary table 01.2006-2007”). Sediment samples were frozen after their sampling and delivered to AUPET stationary laboratory in Almaty in such condition.

Field works of 2007:

4.2.3. Bottom sediments sampling and measurement of soft sediment thickness in wastewater storage pond – Lake Balkyldak: in March, 2007 159 bottom sediment samples were taken from under the ice in 94 sampling points and in September, 2007 35 samples – along the coastline within reed-bed areas in 35 sampling points. Measurements of the sediment depth and thickness were done on 129 sampling points (“Summary table 01.2006-2007”). Sediment samples were delivered to AUPET stationary laboratory in Almaty.

▪ **Personnel Commitments**

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	10
Aksenova Tatiana V.	AUPET	1	20
Kiseleva Raisa A.	AUPET	1	20
Primbetova Galina I.	AUPET	1	20
Sharov Boris A.	AUPET	1	20
Shevchenko Natal'ya N.	AUPET	1	20
Kamberov Rustam I.	AUPET	2	27
Mukhamedzhanov Khamit V.	AUPET	2	6
Uskov Grigoriy A.	AUPET	2	20
Stepanov Vladimir A.	AUPET	3	42
Galieva Elena V.	BMP	1	33
Kirplyuk Eduard V.	BMP	1	21
Kolysheva Ol'ga I.	BMP	1	12
Kosinov Aleksandr N.	BMP	1	30
Ponomarenko Aleksandr S.	BMP	1	6
Grankovskiy Egor P.	BMP	2	12
Lobacheva Tat'yana I.	BMP	2	30
Lyashenko Galina N.	BMP	2	20
Zolotova Nadezhda V.	BMP	2	25
Kuz'min Valeriy S.	PSU	1	50
Mal'kov Igor V.	PSU	1	27
Pastukh Viktor P.	PSU	1	40
Bazarbekov Kairbay U.	PSU	2	10
Kalieva Aida A.	PSU	2	10

Subtask 4.3: To create and analyze the map of Hg contamination of bottom sediments using the software package “ArcGIS – Spatial Analysis”.

4.3.1. The area of the wastewater storage pond – Lake “Balkyldak” in GIS of the Northern industrial area of Pavlodar produced earlier in 2000-2001 was made more detailed and completed with new data from satellite images and archival documents and also from direct measurements with help of portable GPS: vegetation boundary and the bottom contour of the lake were input and its present shore line was made more correct.

4.3.2. The computer map of depths of wastewater storage pond Balkyldak and thicknesses of its bottom sediment were produced according the data of the field works of 2006 and 2007 within GIS of Lake Balkyldak using software ArcGIS, module Spatial Analyst.

4.3.3. Within the framework of GIS of the wastewater storage pond Balkyldak the vector map of its bottom sediments mercury contamination were produced according to “Summary Tables 08.2006 and 08.2007” using Spatial Analyst module of ArcGIS software and also amount of mercury there was calculated i.e. amount of that mercury which came to the pond Balkyldak with wastewater of PO “Kkimprom”; it is equal to **135 336 kg**.

▪ **Personnel Commitments**

Name	Institute	Category	Days
Aksenova Tatiana V.	AUPET	1	20
Kiseleva Raisa A.	AUPET	1	20
Primbetova Galina I.	AUPET	1	20

Sharov Boris A.	AUPET	1	20
Shevchenko Natal'ya N.	AUPET	1	20
Kamberov Rustam I.	AUPET	2	46
Mikhaylenko Natal'ya A.	AUPET	2	18
Mukhamedzhanov Khamit V.	AUPET	2	18
Uskov Grigoriy A.	AUPET	2	30
Yakovleva Lyudmila V.	AUPET	2	5
Zyryanova Nataliya A.	AUPET	2	30
Stepanov Vladimir A.	AUPET	3	54
Amanov Serzhan B.	BMP	1	15
Kirplyuk Eduard V.	BMP	1	12
Kolysheva Ol'ga I.	BMP	1	11
Prikhodko Tatyana V.	BMP	1	16
Smirnova Svetlana Y.	BMP	1	19
Starodubova Valentina F.	BMP	1	14
Abel'denov Saylau K.	BMP	2	11
Balpanov Darkhan S.	BMP	2	9
Mukanov Kasym K.	BMP	2	11
Volkov Oleg E.	BMP	2	19
Zhulikova Xsenia S.	BMP	2	11
Kuz'min Valeriy S.	PSU	1	50
Mal'kov Igor' V.	PSU	1	22
Pastukh Viktor P.	PSU	1	50
Bazarbekov Kairbay U.	PSU	2	12
Kalieva Aida A.	PSU	2	56

Subtask 4.4: To take the samples of biota from the lake Balkyldak and to describe the existing food chains.

In 2006 and 2007 hydrobionts from both the pond Balkyldak and a control lake (Krivoe pond) were gathered for their biological and chemical analyses. Species diversity of representatives of plankton, benthos and fish was determined. Mass survey of fish was carried out for their morphological analysis. Characteristics of ecotypes were determined in the aquatic life sampling points within both the wastewater storage pond Balkyldak and the Krivoe pond ecosystems.

Collected and frozen samples of fish (57 samples in 2006 and 60 samples in 2007), benthos (11 integral samples), and plankton (4 integral samples) were delivered to AUPET for conducting chemical analysis.

Food chains existent in the wastewater storage pond Balkyldak were described.

▪ **Personnel Commitments**

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	14
Aksenova Tatiana V.	AUPET	1	20
Kiseleva Raisa A.	AUPET	1	20
Primbetova Galina I.	AUPET	1	20
Sharov Boris A.	AUPET	1	20
Shevchenko Natal'ya N.	AUPET	1	20
Kuz'min Valeriy S.	PSU	1	60
Mal'kov Igor' V.	PSU	1	26
Pastukh Viktor P.	PSU	1	53
Bazarbekov Kairbay U.	PSU	2	14
Kalieva Aida A.	PSU	2	66

Subtask 4.5: To conduct chemical analysis (including the determination of total mercury content) and morphological studies of the taken samples of biota.

4.5.1. In 2006 and 2007 334 bottom sediment samples were analyzed for the total mercury content. The results of determination of mercury concentration in bottom sediment samples were compiled in “Summary tables 08.2006 and 04.2007” and then were used to create a vector map “Mercury contamination of bottom sediments of wastewater storage pond Balkyldak”.

4.5.2. In 2007 132 samples of the wastewater storage pond Balkyldak biota including 117 fish samples were analyzed for total mercury content. The results were compiled in “Summary tables 09.2006 and 05 and 06.2007”.

▪ **Personnel Commitments**

Name	Institute	Category	Days
Aksenova Tatiana V.	AUPET	1	26
Kiseleva Raisa A.	AUPET	1	26
Primbetova Galina I.	AUPET	1	26
Sharov Boris A.	AUPET	1	26
Shevchenko Natal'ya N.	AUPET	1	26
Uskov Grigoriy A.	AUPET	2	150
Yakovleva Lyudmila V.	AUPET	2	14
Zyryanova Nataliya A.	AUPET	2	153
Stepanov Vladimir A.	AUPET	3	86
Amanov Serzhan B.	BMP	1	15
Kirplyuk Eduard V.	BMP	1	12
Kolysheva Ol'ga I.	BMP	1	10
Prikhodko Tatyana V.	BMP	1	16
Smirnova Svetlana Y.	BMP	1	19
Starodubova Valentina F.	BMP	1	11
Abel'denov Saylau K.	BMP	2	6
Balpanov Darkhan S.	BMP	2	9
Mukanov Kasym K.	BMP	2	11
Volkov Oleg E.	BMP	2	19
Zhulikova Xsenia S.	BMP	2	11
Kuz'min Valeriy S.	PSU	1	85
Mal'kov Igor' V.	PSU	1	28
Pastukh Viktor P.	PSU	1	85
Bazarbekov Kairbay U.	PSU	2	13
Kalieva Aida A.	PSU	2	93
Akhmetov Artur D.	Kaustik	1	4
Kalinkina Elena A.	Kaustik	1	20
Karimov Sharapat S.	Kaustik	1	20
Kosyashnikova Ol'ga M.	Kaustik	1	20
Merenkova Ludmila B.	Kaustik	1	20
Putikova Lyudmila Y.	Kaustik	1	20
Sedletskaia Natal'ya I.	Kaustik	1	20
Shelkopyas Lidiya V.	Kaustik	1	20
Tskay Alexandra I.	Kaustik	1	12
Yepifantseva Tatiana M.	Kaustik	1	20
Zhumabekova Maisa I.	Kaustik	1	20

Subtask 4.6: To identify the pathways of Hg bioaccumulation and to develop the possible solutions to break these pathways.

Together with the Participant Institutions JSC “Kaustik” and PSU as well as with experts in risk assessment and ichthyologists the results of investigation of the biota mercury contamination in the wastewater storage pond Balkyldak and prospects of its further use were discussed including feasibility to apply ichthyologic poisons in order to stop sport fishing of mercury contaminated fish. Taking into account substantial decrease in mercury concentration in water of the wastewater storage pond and fish caught out of the pond during the post-demercurization period the consensus was reached to give recommendation for local authority in output documentation of K-1240p project to continue both their explanatory activity through the mass media such as warning about a danger to use fish from the wastewater pond Balkyldak as a foodstuff and a practice of administrative ban against commercial fishing in the pond Balkyldak.

A question about excavation or immobilization of mercury contaminated bottom sediments of the wastewater storage pond Balkyldak should be examined after decision about its further use would have been made that depends first of all on perspectives of JSC “Kaustik” development. Possible technical solutions for demercurization of the wastewater storage pond Balkyldak were discussed with experts.

▪ Personnel Commitments

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	20
Kamberov Rustam I.	AUPET	2	5
Yakovleva Lyudmila V.	AUPET	2	25
Kalieva Aida A.	PSU	2	22
Ubaskin Alexander V.	PSU	4	45
Akhmetov Artur D.	Kaustik	1	33
Kalinkina Elena A.	Kaustik	1	40
Karimov Sharapat S.	Kaustik	1	30
Merenkova Ludmila B.	Kaustik	1	34
Putikova Lyudmila Y.	Kaustik	1	36
Sedletskaaya Natal'ya I.	Kaustik	1	36
Soloveva Nadezhda V.	Kaustik	1	11
Tskay Alexandra I.	Kaustik	1	43
Yepifantseva Tatiana M.	Kaustik	1	40
Zhumabekova Maisa T.	Kaustik	1	40

Task 5. To draw up and discuss with local stakeholders the recommendations for the 2nd stage of demercurization and other remediation activities in the area of the former PO “Khimprom” (Northern industrial area of Pavlodar), including the recommendation for abolishment or further safe use of the wastewater storage pond – lake Balkyldak:

Subtask 5.1: To discuss the work program and obtained results with Pavlodar regional department of environmental protection and with the managers of Pavlodar Chemical Plant.

5.1.1. The results of the mercury monitoring were discussed a few times with administration of JSC “Kaustik”, Pavlodar Territorial Environmental Protection Authority, Environmental Department of Pavlodar Oblast Akimat and Office of Public Prosecutor of Pavlodar oblast. Permanent and most important subject of the discussion was prevention of fishing from the mercury contaminated wastewater storage pond – Lake Balkyldak that poses a threat to health of Pavlodar population.

5.1.2. On the 16th of August a workshop on the preliminary results of mercury monitoring in the framework of ISTC K-1240 project was arranged for staff of environmental service, NGO and deputies of Pavlodar City at Pavlodar Territorial Environmental Protection Authority. The workshop activity was highlighted in news programs of two Republican (KTK, Kazakhstan) and two regional (Kazakhstan-Pavlodar, Irbis) TV channels.

5.1.3. On December 22, 2006 Public Talks on the results of investigation of the wastewater storage pond – Lake Balkyldak was conducted in Pavlodar within the framework of ISTC K-1240p project (deputies of oblast maslikhat, officials from ecological and sanitary and epidemiological departments, JSC “Kaustik” administration attended the talks). The event was highlighted by two oblast TV channels (Kazakhstan-Pavlodar and Irbis).

5.1.4. On the 15th March 2007 the results of investigation of soil mercury contamination within the industrial site #1 of PCP and in the vicinity as well as mercury emission to atmosphere and infiltration of soluble mercury forms from contaminated soils down to groundwater were discussed with administrations of both Pavlodar Territorial Department of Environmental Protection and JSC “Kaustik”. This induced Pavlodar Territorial Department of Environmental Protection to address a request to managers of ISTC K-1240p project to expand the program of investigation on the Subtask 1.3 with a view to prepare a Feasibility Study of the soil remediation.

5.1.5. The results of monitoring carried out, the final reports on K-1240p project and recommendations on management of residual mercury contamination in Pavlodar were handed over to the Participant Institution JSC “Kaustik” and regional authorities.

▪ Personnel Commitments

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	77
Kuz'menko Larisa V.	AUPET	1	81
Aksenova Tatiana V.	AUPET	1	14
Kiseleva Raisa A.	AUPET	1	14
Primbetova Galina I.	AUPET	1	14
Sharov Boris A.	AUPET	1	14
Shevchenko Natal'ya N.	AUPET	1	14
Kamberov Rustam I.	AUPET	2	24
Mikhaylenko Natal'ya A.	AUPET	2	35
Mukhamedzhanov Khamit V.	AUPET	2	11
Uskov Grigoriy A.	AUPET	2	18
Yakovleva Lyudmila V.	AUPET	2	52
Zyryanova Nataliya A.	AUPET	2	12
Stepanov Vladimir A.	AUPET	3	14
Kuz'min Valeriy S.	PSU	1	28
Mal'kov Igor' V.	PSU	1	14
Pastukh Viktor P.	PSU	1	12
Bazarbekov Kairbay U.	PSU	2	9
Kaliev Aida A.	PSU	2	31
Akhmetov Artur D.	Kaustik	1	24

Subtask 5.2: To hold the workshops, press-conferences and presentation in order to discuss the interim results.

5.2.1. In 2005 websites <http://Hg-Pavlodar.narod.ru> and <http://Hg-Kazakhstan.narod.ru> were created which are updated constantly. The websites contain materials in Russian and English languages about progress of demercurization and post-demercurization monitoring in the Northern industrial area of Pavlodar city.

5.2.2. On the 12th of July AUPET arranged press-tour to inform public of Kazakhstan with the results of the Demercurization Program and also first results of the post-demercurization monitoring for journalists of Kazakhstan at the former PO “Khimprom” and press-conference – at Pavlodar Territorial Environmental Protection Authority. The results of the press-tour were highlighted in news programs of four Republican TV channels (Khabar, 31st, Kazakhstan, Rakhat), two Pavlodar oblast TV channels

(Kazakhstan-Pavlodar, Irbis) and also Radio 31. Publications on the results of the press-tour were located on the official websites: www.inform.kz, www.khabar.kz, www.kazpravda.kz, www.panorama.kz, www.31.kz, www.liter.kz, www.expressk.kz, www.expert.kz, and also in 5 Republican and 6 regional newspapers and magazines.

5.2.3. On the 14-26 August, 2006 the company “Integrated Pollution Management-Knowledge Transfer Network”, University of Oxford, UK (IPM-KTN) held a Workshop “Mercury and Environmental Protection at Pavlodar, Kazakhstan” on the request of Department of Defense as a support for ISTC project K-1240p. On the 14-19 August within the framework of the Workshop meetings of English and American specialists with local authorities and scientists in Astana, Almaty and Pavlodar were arranged including those with Mr. Erlan Idrisov, an ambassador of the Republic of Kazakhstan in UK on the 26th August. On the 20-26 August visits to sites of remediation works within UK were arranged for 8 participants of K-1240p project as well as meetings with experts in the Great Britain. In Oxford University the results of the Project of Demercurization of chlor-alkali production in Pavlodar and the first results of the monitoring on K-1240p project as well as applied and perspective remediation technologies and risks were discussed. Among the others Dr. Simon Jackman and Professor Don Porcelli from Oxford University, Professor Trevor Tanton and Dr. Susanne Ullrich from University of Southampton and Michael Valentine, the first curator of ISTC K-1240p project took part in the Oxford Workshop.

5.2.4. International Scientific Workshop “Environmental Mercury Pollution: Mercury Emissions, Remediation and Health Effects” was held on 28 May – 1 June, 2007 in Astana, Kazakhstan with the support of Global Partnership Program of Canadian Government, Ministry of Environment Protection of the Republic of Kazakhstan and ISTC. One of the purposes of the workshop was exchange of experience in remediation of mercury polluted areas, evaluation of applied technologies efficiency and risks assessment based on the case study of demercurization projects in Pavlodar. 42 specialists from Kazakhstan, Russia, Canada, USA, UK including Dr. Faina Ingel, an expert in risks to human health, a Head of Laboratory of Genetic Monitoring from Moscow, Russia, K.Arani Kajenthira, a post-graduate of Oxford University and Michael Valentine, the first curator of ISTC K-1240p project participated in the workshop. 25 presentations were done including 8 ones related to mercury pollution in Pavlodar. 4 presentations contained the results obtained on ISTC K-1240p project. At the Workshop the technology of the company “GEOtest”, Brno, Czech Republic was presented which lies in pulping soils contaminated with metallic mercury followed by gravitational separation of mercury and is very promising for its application in Pavlodar. Within the frameworks of the workshop the special technical tour was arranged and held successfully for the participants to visit the site of mercury pollution in the Northern industrial area of Pavlodar and to meet with specialists from Pavlodar Territorial Department of Environmental Protection. Also specialists from Ministry of Environment Protection of the Republic of Kazakhstan, Ministry of Industry and Trade of the Republic of Kazakhstan, Committee for Water Resources of the Ministry of Agriculture of the Republic of Kazakhstan took part in the workshop activity which was covered by the republican TV.

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5.2.5. Within the project “Biomercury” funded via 6 Framework Program of the Europe Union two workshops were held: on the 18-19 May 2006 – in Prague, Czech Republic and on the 22-24 February, 2007 – in Southampton, UK, where among other things the programs of demercurization and monitoring of mercury pollution in Pavlodar were discussed as well as possibility to use new technologies for elimination of mercury pollution. Mikhail Ilyushchenko, Nataliya Mikhailenko and Lyudmila Yakovleva, participants of ISTC K-1240p project took part in the workshops as well as Paul Randall, the Partner representative, Professor Trevor Tanton and Susanne Ullrich from Southampton University, Dr. Simon Jackman and K.Arani Kajenthira from Oxford University, Milena Horvat from “Jozef Stefan” Institute, Ljubljana, Slovenia and Dr. Jarosiav Reif from the company “GEOtest”, Brno, Czech Republic.

5.2.6. Mikhail Ilyushchenko, Artur Akhmetov and Lyudmila Yakovleva, participants of K-1240p project were invited by IPM-KTN company at Oxford University, UK to participate in Special Session “Environmental remediation opportunities for 21st Century», held on the 21 May, 2008 in the

framework of the 11th International Chemical Weapons Demilitarisation Conference, CWD 2008 (May 18-22, 2008) Interlaken City, Switzerland. Mikhail Ilyushchenko gave the presentation "Overview of Environmental Remediation Needs in the Republic of Kazakhstan" there and together with Artur Akhmetov, Lyudmila Yakovleva and Dr. Simon Jackman, Director of IPM-KTN participated in discussion of the program of mercury monitoring, remediation and conversion of Pavlodar Chemical Plant as well as efficiency of the technology applied.

5.2.7. At the 9th International Conference on Mercury as a Global Pollutant (Guiyang, China June 7-12, 2009) ISTC special session was held where 9 specialists on mercury pollution from Russia and Kazakhstan took part. On the results of ISTC K-1240p project 6 presentations were done (2 platform presentations and 4 poster ones, on the request of the conference steering committee the presentation of M.A.Ilyushchenko, L.V.Yakovleva "Problems of demercurization of industrial objects within the former USSR" was given twice in two different sessions). In total 8 presentations were given by ISTC K-1240p project participants (one additional presentation was devoted to the application of experience of investigation of mercury pollution in Pavlodar for a case of mercury pollution in Kiev and one more – in Usolie Sibirskoe).

Manuscript and abstract were prepared for International Symposium on Contaminated Soils and Sediments arranged within the framework of an exhibition RemTech 2009, Ferrara 23-24 September 2009: M.A.Ilyushchenko, V.Yu.Panichkin, P.Randall, T.W.Tanton, S.A.Abrashitova, O.L.Miroshnichenko, L.V.Yakovleva "Influence of efficiency of chlor-alkali production cleanup from mercury on groundwater status in Pavlodar City, Kazakhstan". The main subjects of the discussion was evaluation of the remediation technologies efficiency and risks assessment using the experience of the project of demercurization in Pavlodar (including those for the wastewater storage pond Balkyldak with Dr. Faina Ingel, a Head of Laboratory of Genetic Monitoring from Moscow, Russia and Milena Horvat, Head of the Department of Environmental Sciences at "Jozef Stefan" Institute, Ljubljana, Slovenia).

5.2.8. On the 10th June, 2009 during the 9th International Conference on Mercury as a Global Pollutant (Guiyang, China June 7-12, 2009) the meeting was held with specialists from UNEP where possibilities to use the experience of demercurization works in Kazakhstan for preparation of the Report of UNEP on problems of storage of excess mercury in Asia were discussed. A seminar held in Asian Institute of Technologies in Bangkok, Thailand on the 15th June, 2009 where M.A.Ilyushchenko and L.V.Yakovleva participated was devoted to the same subject. After the seminar Asian Regional Centre of UNEP concluded a contract with M.A.Ilyushchenko for providing consultancy service.

5.2.9. The results of the works on ISTC K-1240p project were presented as 26 reports on 24 conferences and workshops (except for those mentioned in sections 5.2.3. - 5.2.8.). See the attachment 2.

▪ Personnel Commitments

Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	96
Kuz'menko Larisa V.	AUPET	1	20
Kamberov Rustam I.	AUPET	2	200
Mukhamedzhanov Khamit V.	AUPET	2	70
Yakovleva Lyudmila V.	AUPET	2	101
Miroshnichenko Oxana L.	IHH	2	15
Panichkin Vladimir Y.	IHH	2	15
Kuz'min Valeriy S.	PSU	1	7
Mal'kov Igor' V.	PSU	1	4
Pastukh Viktor P.	PSU	1	7
Bazarbekov Kairbay U.	PSU	2	2
Kaliev Aida A.	PSU	2	38.5
Ubaskin Alexander V.	PSU	4	5
Akhmetov Artur D.	Kaustik	1	27

Project Management

In the course of ISTC K-1240p project implementation the following was prepared and discussed: replacement of Participant Institution PCP by Participant Institution JSC “Kaustik” due to bankruptcy of PCP, the project Work Plan correction, changes in teams’ staff and budgets, the project extension twice for 13-15 quarters and 16-17 quarters, as well as 17 quarter technical and 2 annual reports. The first and second curators of the project as well as Paul Randall the project coordinator visited AUPET and other Participant Institutions of K-1240p project many times and also participated in field works in the Northern industrial area of Pavlodar city as well as international workshops and conferences where the results of K-1240p project were discussed.

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▪ Personnel Commitments

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Name	Institute	Category	Days
Ilyushchenko Mikhail A.	AUPET	1	206.5
Kuz'menko Larisa V.	AUPET	1	13
Kamberov Rustam I.	AUPET	2	162
Mikhaylenko Natal'ya A.	AUPET	2	47
Yakovleva Lyudmila V.	AUPET	2	173
Ibraeva Alma A.	AUPET	3	167
Stepanov Vladimir A.	AUPET	3	15

3. Summary of Personnel Commitments

	Number of persons	Total days	Total grants, USD
Category I	31	4410	120362
Category II	22	5116	152341
Category III	2	719	13570
Category IV	1	50	1000
Total	56	10295	287273

4. Presentation of project results

Task 1. Three-year post-demercurization monitoring in the Northern industrial area of Pavlodar city reveal expansion of the plume of groundwater mercury contamination beyond the industrial site of PCP to north-north-west direction from the former chlor-alkali production and the former 6th wastewater pumping station as it had been predicted by the results of the computer modeling. At that in spite of absence of risks of both water supply system mercury contamination in Pavlodarskoe village and mercury ingress to the Irtysh River, there is mercury contamination of the topsoil (more than MPC_s, equal to 2.1 mg/kg) and vegetation in sites where mercury-bearing groundwater can rise up to the original ground. The map of soil mercury contamination of the Northern industrial area of Pavlodar (2002) was added with the results of the field investigation of the contaminated topsoil at the area where mercury contaminated groundwater reached the ground surface. Within the industrial area of PCP decrease of mercury concentration in groundwater is extremely irregular (in the middle part of the plume mercury concentration dropped very fast down to the safe level, i.e. lower than 500 ng/L, in the plume 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 water supply system, (ii) remaining interaction of the groundwater with sources of the groundwater feeding with mercury despite containment of the main mercury hotspots.

Hydro-geological data and the results of chemical analysis obtained as a result of groundwater monitoring allowed developing and improving the computer model of the groundwater mercury contamination. They also became the basis of successful conducting field tests of a technology of groundwater bioremediation carried out in 2010-2011 on ISTC K-1477p project. This technology has a perspective to become the most cost effective and efficient way of mercury immobilization in groundwater of the Northern industrial area of Pavlodar city.

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 (extreme mercury concentrations of the order of g/kg were found, that 1000 times as high as MPC_s for soils) despite cleanup works conducted. Clay screens which cover concrete foundations of demolished buildings of chlor-alkali production are washed out with atmospheric precipitation and spring flood waters so that mercury drops are visible on the ground surface. All this causes high emission of mercury vapors to the atmosphere (mercury concentration in near-earth layer in its extreme values exceeded 10000 ng/m³, that is higher not only than MPC_{ra} for residential area equal to 300 ng/ m³, but even than MPC_{wa} for working area) and ingress of soluble mercury forms into groundwater beyond the perimeter of the anti-filtration barrier so called "cut-off wall" which enclose the main underground sources of mercury contamination. Besides persistent high risks to the environment and health of JSC "Kaustik" personnel such a situation does not allow estimating the efficiency of the cut-off wall as a way of mercury hotspots isolation from groundwater.

At the same time it was proved that landfills at the industrial area of PCP and at special ponds for liquid and solid mercury wastes pose no any risk as a source of groundwater and the atmosphere mercury pollution.

A map of the topsoil mercury contamination in a zone of demercurization was produced (2008), which can be basis for development of Feasibility Study of the II phase of demercurization of the industrial area of the former PO "Khimprom", Pavlodar. The most cost effective and promising technology of mercury recovery from the topsoil was chosen of all discussed technologies. It is used by the company "GEOtest, Brno, Czech Republic at the former chlor-alkali production in Vlora city, Albania and lies in pulping contaminated soil followed by gravitational separation of mercury.

Task 2. 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.

Prognosis of the plume of groundwater mercury contamination spread given for 30 years (2007-2037) suggests high risk of formation of new hotspots of mercury contamination of soil at the territory between the industrial site #1 and the wastewater storage pond Balkyldak due to transport of soluble mercury to a zone of aeration. At the same time there is no threat of mercury pollution to both the Irtysh River and water-supply wells of Pavlodarskoye village if hydro-geological conditions which determine direction of mercury contaminated groundwater movement remain the same. At that it was pointed out that unfavorable change of hydro-geological conditions can be caused only by some technogenic reasons.

Task 3. Field investigations proved spread of underground waste oil sump more than 2 m thick at the depth of 2.6 m over the groundwater table 25 m long beyond north-west corner of the industrial area of Pavlodar Oil Refinery. The oil sump is a source of groundwater feeding with soluble oil products.

Created computer hydro-dynamic model of spread of groundwater contamination with oil products between Pavlodar Oil Refinery and Pavlodarskoye village allowed calculating a trajectory of the plume of contamination which go to the Irtysh River through the middle of the village and proving high probability of the oil product ingress into the village water supply wells and respectively high potential risks to health of the village inhabitants.

Task 4. Field and chemical analytical studies conducted in 2006-2008 allowed developing GIS of the wastewater storage pond Balkyldak and producing a vector map of mercury contamination of its bottom sediments. Amount of mercury which came to the pond Balkyldak with wastewater of PO "Kkimprom" was calculated to be **135 336 kg**. This figure allows estimating mercury losses at similar chlor-alkali productions of the former USSR, which disposed their wastewater to flow-through water bodies. The map of mercury contamination of the pond Balkyldak can be a basis for development of a Feasibility Study and its demercurization. The most cost effective and promising technology of mercury contaminated bottom sediments removal was chosen of all discussed technologies. It was used in Minamata Bay, Japan and lies in pumping soft sediments using a hydraulic dredge and transporting them to some isolated pond on the shore of Lake Balkyldak followed by the sediment burial in the same pond.

Biota and possible food chains of the wastewater pond Balkyldak were studied. Taking into account considerable decrease of mercury concentration in after-demercurization period both in the pond water (lower than MPC_w for natural water) and in fish caught out of the pond (not higher than $1MPC_{npf}$ for non predator fish for average values and 4 MPC_{npf} for non predator fish for sporadic values) and respectively decrease of risks to human health the local authority was given a recommendation to continue both their explanatory activity through the mass media such as warning about a danger to use fish from the wastewater pond Balkyldak as a foodstuff and a practice of administrative ban against commercial fishing in the pond Balkyldak.

A question about removal of mercury contaminated bottom sediments of the wastewater storage pond Balkyldak should be examined after decision about its further use would have been made that depends first of all on perspectives of JSC "Kaustik" development.

Task 5. Recommendations on the II phase of demercurization and other rehabilitation activity at the Northern industrial area of Pavlodar city including the area of the former PO "Khimprom" were discussed and provided to the regional authority.

see Attachment 1. List of published papers and reports without abstracts
see Attachment 2. List of presentations at conferences and meetings without abstracts

5. Co-operation with foreign collaborators/partners

5.1. Paul Randall, the project coordinator, the Partner representative, Senior Chemical Engineer, EPA Office of Research and Development, Cincinnati, USA:

- He received necessary data of monitoring in Pavlodar and gave literature data difficult of access for preparation of joint publications and presentations at conferences, rendered consultancy and assistance in purchase of new version of GMS 6.0 software;
- participated twice in field works in Pavlodar: In September 2006 and September 2007;
- held 7 meetings with participants of ISTC K-1240p project, including 4 ones – in Kazakhstan (Almaty, Pavlodar), 1 – in UK (Southampton) and 2 – in USA (Cincinnati, Madison) where the progress of works on the project was discussed;
- together with personnel of ISTC K-1240p project participated in the Workshop “Commercialization of results of scientific and technical developments in Kazakhstan” (Almaty, 19-20 September, 2006) and in the Workshop “Biomercurey” in the University of Southampton (Southampton, UK, 19-23 February, 2007);
- was a co-author of a paper in journal “The Magazine for Environmental Managers”;
- was a co-author of 10 presentations at 7 international conferences.

5.2. Trevor W. Tanton, the project collaborator, professor of Chair of Environmental Technology, the University of Southampton, UK.

- He received necessary data of monitoring in Pavlodar and gave literature data difficult of access for preparation of joint publications and presentations at conferences;
- held 2 meetings with ISTC K-1240p project participants in Kazakhstan (Almaty, Pavlodar) and 2 ones - in UK (Southampton, Oxford) where the progress of works on the project was discussed;
- together with personnel of ISTC K-1240p project participated in the Workshop “Mercury and Environmental Protection at Pavlodar, Kazakhstan” in Oxford University (Oxford, 20-26 August, 2006) and in the Workshop “Biomercurey” in the University of Southampton (Southampton, UK, 19-23 February, 2007);
- was a co-author of 2 papers in journal The Science of the Total Environment;
- was a co-author of 10 presentations at 7 international conferences.

5.3. Dr. Susanne M. Ullrich, researcher of School of Civil Engineering and the Environment , the University of Southampton, UK.

- She received necessary data of monitoring in Pavlodar and gave literature data difficult of access for preparation of joint publications and presentations at conferences;
- held 2 meetings with ISTC K-1240p project participants in UK (Southampton, Oxford) where the progress of works on the project was discussed;
- was a co-author of 2 papers in journal The Science of the Total Environment;
- was a co-author of 1 presentation at 1 international conference.

5.4. Dr. **Simon Jackman**, Director Integrated Pollution Management-Knowledge Transfer Network, University of Oxford, UK:

- together with personnel of ISTC K-1240p project participated in the Workshop “Mercury and Environmental Protection at Pavlodar, Kazakhstan” in Oxford University (Oxford, 20-26 August, 2006), in the Workshop “Biomercurey” in the University of Southampton (Southampton, UK, 19-23 February, 2007) and at the Special Session of “Environmental remediation opportunities for 21st Century», in the framework of the 11th International Chemical Weapons Demilitarization Conference, CWD 2008 (May 18-22, 2008) Interlaken City, Switzerland;
- held 3 meetings with ISTC K-1240p project participants in UK (Southampton, Oxford) and Switzerland (Interlaken) where the progress of works on the project was discussed;
- was a co-author of 1 presentation at 1 international conference.

5.5. Dr. **Don Porcelli**, University Lecturer, Department of Earth Sciences, University of Oxford, UK:

- He participated in field works in Pavlodar in September 2007;
- together with personnel of ISTC K-1240p project participated in the Workshop “Mercury and Environmental Protection at Pavlodar, Kazakhstan” in Oxford University (Oxford, 20-26 August, 2006);
- held 2 meetings with ISTC K-1240p project participants in Kazakhstan (Pavlodar) and - in UK (Oxford) where the progress of works on the project was discussed;
- was a co-author of 1 presentation at 1 international conference.

5.6. **K.Arani Kajenthira**, post-graduate of Department of Earth Sciences, University of Oxford, UK:

- She participated in field works in Pavlodar in September 2007;
- together with personnel of ISTC K-1240p project participated in the Workshop “Biomercurey” in the University of Southampton (Southampton, UK, 19-23 February, 2007) and International Workshop “Environmental Mercury Pollution: Mercury Emissions, Remediation and Health Effects” (Astana, Kazakhstan, 28 May – 1 June, 2007);
- had meetings with ISTC K-1240p project participants in Kazakhstan (Astana, Pavlodar) and - in UK (Oxford) where the progress of works on the project was discussed;
- was a co-author of 1 presentation at 1 international conference.

5.7. Dr. **Jarosiav Reif**, Senior Project Manager of the company GEOTestBRNO, Brno, Czech Republic:

- He participated in field works in Pavlodar in July 2006;
- together with personnel of ISTC K-1240p project participated in the Workshops “Biomercurey” in Prague (Prague, Czech Republic, 18-19 May, 2006) and in the University of Southampton (Southampton, UK, 19-23 February, 2007);
- held 3 meetings with ISTC K-1240p project participants in Kazakhstan (Pavlodar), in Czech Republic (Prague) and in UK (Southampton) where the progress of works on the project was discussed.

5.8. Dr. **Milena Horvat**, Head of the Department of Environmental Sciences at “Jozef Stefan” Institute, Ljubljana, Slovenia:

- She participated in conducting chemical analyses for total mercury and methyl mercury content in groundwater samples taken in July, 2006;
- together with personnel of ISTC K-1240p project participated in the Workshops “Biomercury” in Prague (Prague, Czech Republic, 18-19 May, 2006) and in the University of Southampton (Southampton, UK, 19-23 February, 2007) and in the Special Session at the 9th International Conference on Mercury as a Global Pollutant (Guiyang, China June 7-12, 2009);
- held 4 meetings with ISTC K-1240p project participants: in Czech Republic (Prague), in UK (Oxford), in USA (Madison) and China (Guiyang) where the progress of works on the project was discussed.

6. Co-operation with CIS sub-contractors

Faina I. Ingel, Doctor of Biological Sciences, a Head of Laboratory of Genetic Monitoring, A. Sytin Research Institution of Humam Ecology and Hygiene of the Environment, Moscow, Russia:

- together with personnel of ISTC K-1240p project participated in ISTC Technical Workshop within the framework of 29th AMOP conference (Vancouver, Canada, 6-8 June, 2006), in International Scientific Workshop “Environmental Mercury Pollution: Mercury Emissions, Remediation and Health Effects” (Astana, Kazakhstan, 28 May – 1 June, 2007) and in the Special Session at the 9th International Conference on Mercury as a Global Pollutant (Guiyang, China June 7-12, 2009);
- held 6 meetings with ISTC K-1240p project participants: 1 meeting – in Canada (Vancouver), 1 – in China (Guiyang), 4 – in Kazakhstan (Astana, Almaty, Pavlodar) where the progress of works on the project and possible risks to human health in the Northern Industrial area of Pavlodar city were discussed.

Interaction of Participant Institutions and the project management:

- AUPET together with JSC “Kaustik” carried out the monitoring study of the mercury contamination of groundwater in the Northern industrial area of Pavlodar;
- AUPET together with JSC “Kaustik” will study the extent of mercury contamination of soils and pastures in areas where the upward movement of polluted groundwater was possible;
- BMP together with JSC “Kaustik” conducted the monitoring study regarding to the groundwater contamination with oil products in Northern industrial area of Pavlodar as well as soils sampling within the industrial site of the former chlor-alkali production;
- AUPET together with PSU determined the levels of total mercury content in bottom sediments and biota of the wastewater storage pond – Lake Balkyldak;
- AUPET together with IHH assessed the risks associated with the residual mercury contamination of groundwater and the wastewater storage pond – Lake Balkyldak;
- IHH together with AUPET assessed the risks posed by contamination of groundwater with oil products;
- AUPET conducted chemical analyses of water and soil samples for total mercury content, BMP – chemical analyses of water samples for soluble oil products and soils samples – for total mercury.
- IHH with help of AUPET upgraded and improved the groundwater model for the Northern industrial area of Pavlodar. Based on the model IHH made prognoses for the future spread of groundwater contaminated with Hg and oil products;
- AUPET together with IHH drew up and provided local stakeholders and state authorities with the proposals for risk management in Northern outskirts of Pavlodar city including probability to carry out additional works on demercurization of the former PO “Khimprom” and bringing the wastewater storage pond – Lake Balkyldak to safe conditions.

7. Procurement

Pos. 1).	Name	Status / Comments
1	Fistream MultiPure Twin Cartridge Ultrapure Deioniser	Cat. FistreamInternational DCF-732-W, Location: Pavl;odar, JSC "Kaustic".
2	MS Office 2007 Win32 Russian CD	Location: Pavl;odar, JSC "Kaustic".
3	MS Office 2007 Win32 Russian CD	Location: Pavl;odar, JSC "Kaustic".
4	Notebook	HP ProBoox 4710s: Core 2 Duo-T5870- 2000/2x1Mb/2048/250Gb/DVD- RW/SB/512Mb/FM/Gether- 32/WiFi/Bluetooth/HDMI/17.3" TFT/Spk/Win Vista HB, Location: Pavl;odar, JSC "Kaustic".
5	Digital copier	Canon iR-2016J (A3), Location: Pavl;odar, JSC "Kaustic".
6	Notebook	Fujitsu AMILO Li 3710: Core 2 Duo-T3000- 1800/1Mb/2048/160Gb/DVD-RW/SB/- /FM/FEther-32/WiFi/Camera/15.6" TFT/Spk/Win Vista HB, serial # YL1R06317, Location: Pavl;odar, JSC "Kaustic".
7	Notebook	Fujitsu AMILO Li 3710: Core 2 Duo-T3000- 1800/1Mb/2048/160Gb/DVD-RW/SB/- /FM/FEther-32/WiFi/Camera/15.6" TFT/Spk/Win Vista HB. serial # YL1R06532, Location: Pavl;odar, JSC "Kaustic".
8	Express carbone analyzer	AN-7560M, Location: Pavl;odar, JSC "Kaustic".
9	Balance	BL620S, 620 g / 0.01 g, Shimadzu, serial # D427200350, Location: Pavl;odar, JSC "Kaustic".
10	Balance	AX200, 200 g / 0.1 mg, Shimadzu, serial # ДИ39500414, Location: Pavl;odar, JSC "Kaustic".
11	Ion meter	I-160MI, 25800046, serial # 1386, Location: Pavl;odar, JSC "Kaustic".
12	Distiller	YA-ZD-10, 10 L/h, 2560002, Location: Pavl;odar, JSC "Kaustic".
13	Drying oven	SHC-80-01 CPU, +50 ...+2000C, 2090004, Location: Pavl;odar, JSC "Kaustic".
14	Pipette Research Eppendorf 2-20 mkl	Cat/ Eppendorf 3111 000.130, Location: Pavl;odar, JSC "Kaustic".
15	Pipette Research Eppendorf 2-20 mkl	Cat/ Eppendorf 3111 000.130, Location: Pavl;odar, JSC "Kaustic".
16	Pipette Research Eppendorf 20-200 mkl,	Cat. Eppendorf 3111 000.157, Location: Pavl;odar, JSC "Kaustic".
17	Pipette Research Eppendorf 20-200 mkl,	Cat. Eppendorf 3111 000.157, Location: Pavl;odar, JSC "Kaustic".
18	Pipette Research Eppendorf 100-1000 mkl	Cat/ Eppendorf 3111 000.165, Location: Pavl;odar, JSC "Kaustic".
19	Pipette Research Eppendorf 100-1000 mkl	Cat/ Eppendorf 3111 000.165, Location: Pavl;odar, JSC "Kaustic".
20	Flowmeter form King 7430	series SS 1/4F ss EP MM OV, Cat.KingInstrument Nr. 74C-123G081-3-2-1-1-2-0, Location: Pavl;odar, JSC "Kaustic".

21	Flowmeter form King 7430	series SS 1/4F ss EP MM OV, Cat.KingInstrument Nr. 74C-123G081-3-2-1-1-2-0, Location: Pavl;odar, JSC "Kaustic".
22	Pipette Research Eppendorf 500-5000 mkl	Cat. Eppendorf 3111 000 173, Location: Pavl;odar, JSC "Kaustic".
23	Pipette Research Eppendorf 500-5000 mkl	Cat. Eppendorf 3111 000 173, Location: Pavl;odar, JSC "Kaustic".
24	Pipette Research Eppendorf 500-5000 mkl	Cat. Eppendorf 3111 000 173, Location: Pavl;odar, JSC "Kaustic".
25	Analyzer	Fluorat-02-03M, serial # 5456, Location: Pavl;odar, JSC "Kaustic".
26	MM type Gas Liquid Separator, Cat. M025G004	Cat. M025G004, Location: Pavl;odar, JSC "Kaustic".
27	Millennium Merlin 1631 System for low level mercury Determination, supplied ready to run and includes atomic-fluorescence detector, vapor generator, gold amalgam pre-concentrator integrated perma-pure dried system, Millennium windows software, interface cables, installation kit, consumables kit, user manuals. Cat. PS Analytical 10.035	Location: Pavl;odar, JSC "Kaustic".
28	Sample Valve	Cat. M025V002, Location: Pavl;odar, JSC "Kaustic".
29	Sample Valve	Cat. M025V002, Location: Pavl;odar, JSC "Kaustic".
30	GMS 6.0: Complete Package Network Hardware Lock with Manual	Location: Almaty, Institute of Hydrogeology and Hydrophysics (Now - Institute of Hydrogeology and Geoecology)
31	LCD-Monitor 19" LG L1910B	511NTEP9T356, Location: Almaty, Institute of Hydrogeology and Hydrophysics (Now - Institute of Hydrogeology and Geoecology)

1) in accordance to the Equipment and Materials Summary of tables 2 and 3 of the Work Plan

8. Conclusion, Problems, Suggestions

- The results of ISTC K-1240p project have been provided to local authorities for continuation of monitoring of mercury contamination at the Northern industrial area of Pavlodar city and preparation of the II phase of demercurization works at the industrial site #1 of PCP. The results of monitoring and computer modeling of groundwater contamination with oil products require continuation of field studies and first of all creation of a network of observation boreholes along the trajectory of the possible plum of groundwater contamination with oil products. Unfortunately this direction of the research on K-1240p project did not find any support of the local authority because it infringed on interests of the operating Pavlodar Oil Refinery. However, sooner or later, these data will be claimed.
- Final reports on ISTC K-1240p project will be put out in the INTERNET at the website <http://Hg-Pavlodar.narod.ru> and will become accessible for all comers by the same way how it was done with all quarter technical and annual reports on the project.
- Based on the material obtained on ISTC K-1240p project it has become possible to draw up requirements specifications for development of Feasibility Study for three projects: (i) on remediation of mercury contaminated bottom sediments of the wastewater storage pond Balkyldak; (ii) on cleaning and restoration of mercury contaminated soils at the industrial site of the former chlor-alkali

production; (iii) on immobilization of mercury in groundwater. The original biotechnology of mercury immobilization in groundwater was being developed on ISTC K-756p and K-1477p projects in parallel and due to support of ISTC K-1240p project. The biotechnology has been brought to a stage of successful completion of field trials of the pilot plant.

- The results obtained on K-1240p project are of environmental and social importance.

Attachment 1: List of published papers and reports:

1. M.A.Ilyushchenko, L.V.Yakovleva. Change of a concept for technologies of remediation of water bodies and territories contaminated with mercury. In book: Mercury in the biosphere: ecological-geochemical aspects. Proceedings of International Symposium (Russia, Moscow, GEOHI RAH, 7-9 September, 2010). M. GEOHI RAN, 2010, P. 414-418 (Ru).
2. L.V.Yakovleva, M.A.Ilyushchenko. Experience of demercurization of chlor-alkali and acetaldehyde productions in Kazakhstan. In book: Mercury in the biosphere: ecological-geochemical aspects. Proceedings of International Symposium (Russia, Moscow, GEOHI RAH, 7-9 September, 2010). M. GEOHI RAN, 2010, P. 456-460 (Ru).
3. V.Yu.Panichkin, O.L.Miroshnichenko, M.Ilyushchenko, T.W.Tanton, P.Randall. Mathematical model of groundwater mercury contamination at the Northern part of Pavlodar industrial region (the Republic of Kazakhstan). In a book: Mercury in the biosphere: ecological-geochemical aspects. Proceedings of International Symposium (Russia, Moscow, GEOHI RAH, 7-9 September, 2010). M. GEOHI RAN, 2010, P. 440-445 (Ru).
4. M.A.Ilyushchenko, L.V.Yakovleva. Change of a concept of remediation in case of mercury contamination. CD-ROM Proceedings 11-th International UFZ-Deltares/TNO Conference on Management of Soil, Groundwater & Sediments. Consoil 2010 (Salzburg, Austria 22-24 September 2010).
5. L.V.Yakovleva, M.A.Ilyushchenko. Experience of demercurization of chlor-alkali and acetaldehyde productions in Kazakhstan. CD-ROM Proceedings 11-th International UFZ-Deltares/TNO Conference on Management of Soil, Groundwater & Sediments. Consoil 2010 (Salzburg, Austria 22-24 September 2010).
6. A.V.Ubaskin, A.P.Bondarenko, B.A.Tuleubaev, G.A.Baimukhanova. Experience of students and schoolchildren participation in an international environmental project in basin of the Middle Irtysh. Materials of IV International scientific-practical conference "Actual environmental problems" (Kazakhstan, Karaganda 09-10.12.2010), Karaganda, 2010, P. 229-234 (Ru).
7. A.P.Bondarenko, A.V.Ubaskin. Realization of a complex approach when studying a technogenic ecosystem with participation of students and schoolchildren. International conference "Rivers of Siberia" (16-18 April, 2010), Russia, Tomsk, 2010, P. 20-22 (Ru).
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Attachment 2: List of presentations at conferences and meetings:

1. M.A.Ilyushchenko, L.V.Yakovleva. Change of a concept for technologies of remediation of water bodies and territories contaminated with mercury. In book: Mercury in the biosphere: ecological-geochemical aspects. International

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2. L.V.Yakovleva, M.A.Ilyushchenko. Experience of demercurization of chlor-alkali and acetaldehyde productions in Kazakhstan. In book: Mercury in the biosphere: ecological-geochemical aspects. International Symposium (Russia, Moscow, GEOHI RAH, 7-9 September, 2010).
 3. V.Yu.Panichkin, O.L.Miroshnichenko, M.Ilyushchenko, T.W.Tanton, P.Randall. Mathematical model of groundwater mercury contamination at the Northern part of Pavlodar industrial region (the Republic of Kazakhstan). In book: Mercury in the biosphere: ecological-geochemical aspects. International Symposium (Russia, Moscow, GEOHI RAH, 7-9 September, 2010).
 4. M.A.Ilyushchenko, L.V.Yakovleva. Change of a concept of remediation in case of mercury contamination. 11-th International UFZ-Deltares/TNO Conference on Management of Soil, Groundwater & Sediments. Consoil 2010 (Salzburg, Austria 22-24 September 2010).
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