

Ecological Society “Ruzgar”, Azerbaijan Republic

**STUDY AND SURVEY PROJECT TO DETERMINE THE FLUXES OF MAJOR
CONTAMINANTS FROM THE KURA TO CASPIAN SEA (MINGECHAUR
RESERVOIR TO KURA RIVER DELTA)**

(Caspian Environmental Program)

Final Report of the project Ref.Rer/03/G31(00034997) , supported by UNOPS

Baku-2005

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1 Organizational

MENR of Azerbaijan and CEP by supporting of UNDP agreed with NGO Rusigar to organize of 1st professional level monitoring of POPs in Kura-Araks basin till Caspian Sea. Rusigar contracted professional environmental research company Azecolab to implement of standard sampling and lab analytical processes.

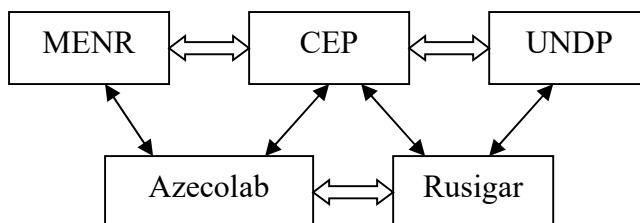


Fig. 1 Project organizational structure

Azecolab is professional company specialized in implementation of research level environmental projects and services both for local and international partners (www.azecolab.com). Research components in his project Azecolab organize in frame of “Physical Environmental Research Center (PERC)”, that was organized cooperatively by Institute of Radiation Problems of National Academy of Science and Civilian Research Development Foundation (CRDF- www.crdp.org). Scientific aspects of his projects continue in frame of “Environmental Physics and Chemistry Lab” (www.epcl.org) with involving of scientists, post-graduate and master students.

PERC and Azecolab involved into Kura-Araks watershed project beginning from 2002 in frame of NATO-OSCE SFP 977991 project (<http://www.kura-araks-natosfp.org>). 1stly SFP 977991 intended to organize of monitoring only list of heavy metal (Ag, As, Cd, Cr, Co, Cu, Hg, Mn, Mo, Ni, Pb, Zn) and common characteristics (T, Ec, pH, DO, TDS, TSS, Na, K, Mg, Ca, Cl, SO₄, HCO₃, TN, TP) in 35 points of Kura-Araks and its main tributaries in monthly bases beginning from January 2004. But NATO and OSCE have decided to extend of project and add monitoring of radionuclides and POPs also into monitoring list.

Azecolab started to develop of POPs component methods beginning from end of 2002 after purchasing of full set of chromatography equipments (GC/ECD, HPLC/FL, GC/MS). As results Azecolab had registered in the **Global POPs laboratory inventory list** (<http://www.chem.unep.ch/gmn/gmnlabs/default.htm>) and representative lab from Azerbaijan.

New stage in development of POPs methods in Azecolab began of the “ANALYTICAL PERFORMANCE STUDY” program around DETERMINATION OF CHLORINATED PESTICIDES AND PETROLEUM HYDROCARBONS IN SEDIMENTS performed by Marine Environment Laboratory (MEL) International Atomic Energy Agency. Participation in this program allow to Azecolab to discover some possible problems with marine sediment samples in stage of sample pre-treatment.

2 Introduction

CEP had planned project pointed to:

Study and Survey Project to Determine the fluxes of major contaminants from the Kura to Caspian Sea (Mingechaur Reservoir to Kura Delta) (Draft Work Plan-2)

2.1 Preliminary Objective (Provided by Rasim Sattarzade)

The screening survey of coastal sediments in the first phase of GEF support to CEP clearly demonstrated that Persistent Toxic Substances (PTS), in particular organochlorinated pollutants were one of the main transboundary concerns for the Caspian Sea. Evidence of their destructive presence and impact on the environment was also indicated in seal, sturgeon and bony fish tissue biopsies undertaken by the World Bank's Ecotoxicology project. With regard to pesticides and banned substances such as DDT, many regional experts refused to believe that it was a current problem, stating that the levels of DDT were a result of the expansion of agriculture in the region during the 1960's and 1970's prior to the ban on the substance. But the analysis of DDT and its breakdown products clearly showed that the chemical is still in use in the region. Therefore one of the most pressing problems for the Caspian is the uncontrolled and illegal use of organochlorinated pesticides such as DDT.

In order to address to this problem in the region, CEP-II has defined number of activities under the ***OUTCOME E: aiming to develop a Regional and National Action Plans addressing the activities contributing to transboundary Persistent Toxic Substances (PTS) including persistent organic pollutants, oil products and heavy metal pollution.*** One of these activities under the OUTCUM E is ***Activity E2:*** which includes selection of two pilot project areas in the region, undertake a survey of usage and stockpiling of pesticides, undertake a stakeholder education programme and demonstrate the use of Integrated Pest Management (coordinated with any national POPs Enabling Activity inventories to avoid duplication).

In connection to follow up the above mentioned pilot projects, the following project proposals were discussed in 3rd Pollution Regional Advisory Group (P-RAG), which was held at the CEP-PCU in Tehran (Mar 6-8, 2005):

1. POPs pesticides stocks and wastes identification and interim storage
2. Integrated Pest Management
3. River basin investigation of Hot-spots for POPs pesticides
4. Demonstration Disposal Facility (Technology) for the POPs destruction

Participants agreed that at this stage it is impossible to make final decision concerning the project design. Finally the meeting decided that regional activities first will be a survey focusing on identification of obsolete pesticides hot spots in the region (1st proposal: *POPs pesticides stocks and wastes identification and interim storage "SPPS"*). The results of this survey will be used for the evaluation of the best use of available resources and again re-evaluate the full project direction and implementation.

The objective of SPPS is to assess the existing status of 3 major obsolete or abandoned chlorinated pesticides storage sites in each country where the Caspian Sea is at immediate risk including the location, general site characteristics, amount and type of pesticides. This survey will consist of brief inventory of chlorinated pesticides storage sites on the basis of national inventory of POPs enabling programme or national official or reported data and information in Caspian region, sampling of stored material up to three major storage sites and analysis of the samples for chlorinated pesticides in one designated laboratory.

2.2 Updated Objectives (provided by Reza Sheikholeslami)

One of the major targets in CEP-II period is to improve the water quality of the Caspian Sea. In this connection, the proposed activities have been defined in **Outcome D and E** of the project document.

In order to have a better understanding of the contribution of Kura River to pollution loading (PTS) in the Caspian Sea, a Study and Survey project (KM-SSP) under **Outcome D** for determination of the flux of major contaminants from the Kura - Mingechaur Reservoir has been proposed. For the objective of the KM-SSP the upstream of the Kura River is treated as a point source at the Mingechaur Reservoir

The general objective of the KM-SSP is to determine the fluxes of major persistent toxic substances ***PTS*** from the Kura river basin located in Azerbaijan Republic. The KM-SSP will undertake a contaminant survey to determine levels of contaminants in Suspended Materials during critical flow periods. In known sites, before and after the Kura-Aras confluent, suspended material from the river will also be taken and analyzed for PTS in order to determine the difference of contaminant flux between Kura and Aras. The primary specific objectives of the survey were:

1. Determine the levels of major ***PTS*** in Suspended Materials (SM) of Kura River prior reaching to the Mingechnaur reservoir during critical flow (highest and lowest flow period)
2. Determine the levels and changes of major ***PTS*** in SM during the critical flow in downstream part of Mingechnaur reservoir (extending from Mingechnaur Dam down to the Kura-Aras confluent) at certain locations
3. Determine the levels and changes of major PTS in SM during the critical flow in certain points of the river prior reaching to the Caspian Sea

Due to the very low concentration of SM in water at Mingechnaur Reservoir which the SM of its inflowing water currently being trapped by Shamkir and Enikend Dams and contribution of two other rivers to Mingechnaur Reservoir (Alzami and Iori Rivers) the specific objectives of the project finally limited only to the last 2nd and 3rd objectives as mentioned in above.

3 Forming of Project Implementation Plan

3.1 1st stage

As this is the 1st attempt of POPs to collect of POPs components data in Kura and Araks, there were some organization problems.

1st stage: MENR and CEP ask Azecolab to organize water sampling around of Mingechnaur Dam, point of combining of Kura and Araks and in Kura delta till June 2005.

Azecolab had discussed of interesting points for samples using of simplified hydrology model of Azerbaijan parts of Kura-Araks watershed.

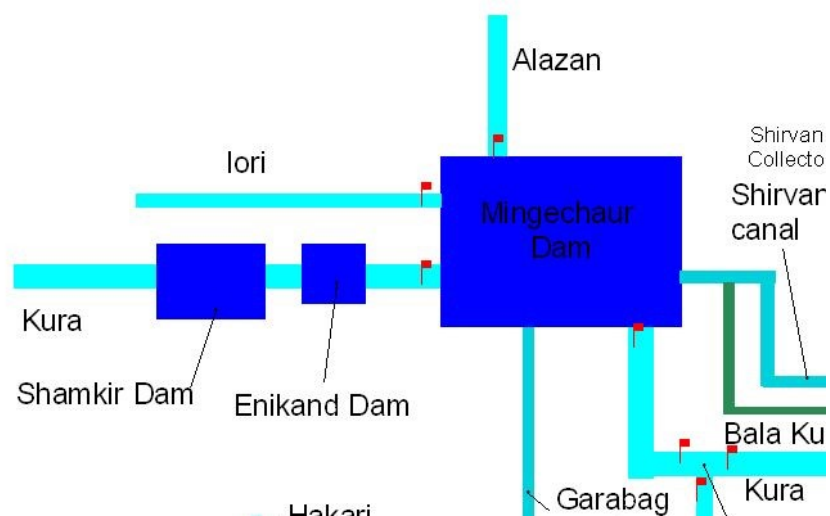


Fig. 2 Model discussed in start of project activity

At this stage, Azecolab agreed with MENR to collect of 10 L water from each of 10 points and lab extract to determine of total HM, PAH, PES and PCB (both dissolved and in suspended matter (SM)).

3.2 2nd stage:

CEP adviser Dr R.Sheikholeslami and Azecolab Director Dr B.Suleymanov after discussion of 1st sampling results have agreed to organise suspended matter sampling in June from only 6 sampling and August and additionally bottom sediment sampling in Mingechar city.

3.3 Agreed SM sampling procedures

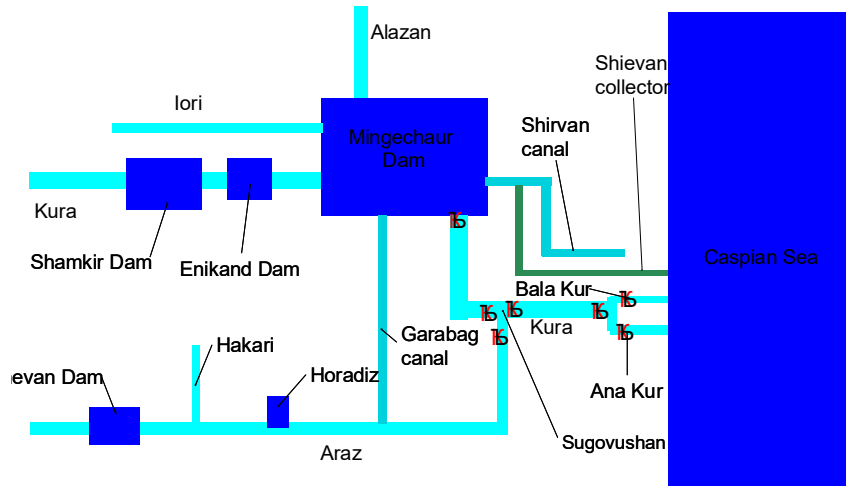


Fig. 3 Agreed sampling point

- Azecolab was engaged to sample of SM in June and August in 6 points and additionally 1 Kura bottom sediment sampling from Mingechar city in August.
- Sampling procedure involve 50-100 water sampling by using of 5 L standard water sampler and SM trapping by using of standard filtration equipment via 0.45 um filter.

4 Azecolab sampling report

4.1 June Sampling

For June month Azecolab had planned of the following works:

Tab. 1 June sampling schedule			
Taken for Implementation:	13.06.05		
Test service N:	991		
Controlled by:	Muradov		
Task type	Performer	Start date	Finish date
QC procedures	Muradov	13.06.05	10.08.05
Sampling from 6 Stations	Hasanov	16.06.05	24.06.05
On site Field Filtration	Ibrahimov	16.06.05	24.06.05
Sample Custody	Mamedova	25.06.05	25.06.05
PCB analyses	Huseynov, Ibadov, Abasova	26.06.05	15.07.05
Pesticides analyses	Huseynov, Ibadov, Abasova	26.06.05	15.07.05
PAH analyses	Huseynov, Ibadov, Abasova	26.06.05	15.07.05
HM analyses	Akhmedov, Balayev, Safarova	26.06.05	15.07.05

Below of the samples registration data in Azecolab:

Tab. 2 Lab sample registration							
June 2005		Kura-till sugovushan	Araz	Kur After Sugovushan	Kura-Neftchala	Ana Kur	Bala Kur
Dry Mass	g	25.70	16.81	25.99	32.86	33.24	29.14
Filtered water	L	53.33	62.45	56.79	55.65	55.65	62.80
SM	g/L	0.48	0.27	0.46	0.59	0.60	0.46

4.2 August Sampling

Tab. 3 August sampling schedule			
Taken for Implementation:	21.08.05		
Test service N:	1053		
Controlled by:	Suleymanov		
Task type	Performer	Start date	Finish date
QC procedures	Abasova	21.08.05	30.09.05
Sampling from 6 Stations	Hasanov	22.08.05	30.08.05
On site Field Filtration	Ibrahimov	22.08.05	30.08.05
Sample Custody	Mamedova	31.08.05	31.08.05
PCB analyses	Huseynov, Ibadov, Abasova	01.09.05	30.09.05
Pesticides analyses	Huseynov, Ibadov, Abasova	01.09.05	30.09.05
PAH analyses	Huseynov, Ibadov, Abasova	01.09.05	30.09.05
HM analyses	Akhmedov, Balayev, Safarova	01.09.05	30.09.05

Below of the samples registration data in Azecolab:

Tab. 4 August sampling registration							
August 2005		Kura-till sugovushan	Araz	Kur After Sugovushan	Kura-Neftchala	Ana Kur	Bala Kur
Dry Mass	g	17.38	9.21	10.47	9.81	10.44	9.82
Filtered water	L	52.75	58.25	54.19	56.34	59.12	57.1
SM	g/L	0.33	0.16	0.19	0.17	0.18	0.17

Additionally in August had sampled 1 kg bottom sediment samples near bridge on Kura in Mingechar city (after Mingechar dam).

5 Sampling point Map and pictures



Fig.3 Mingechar Dam Sampling point

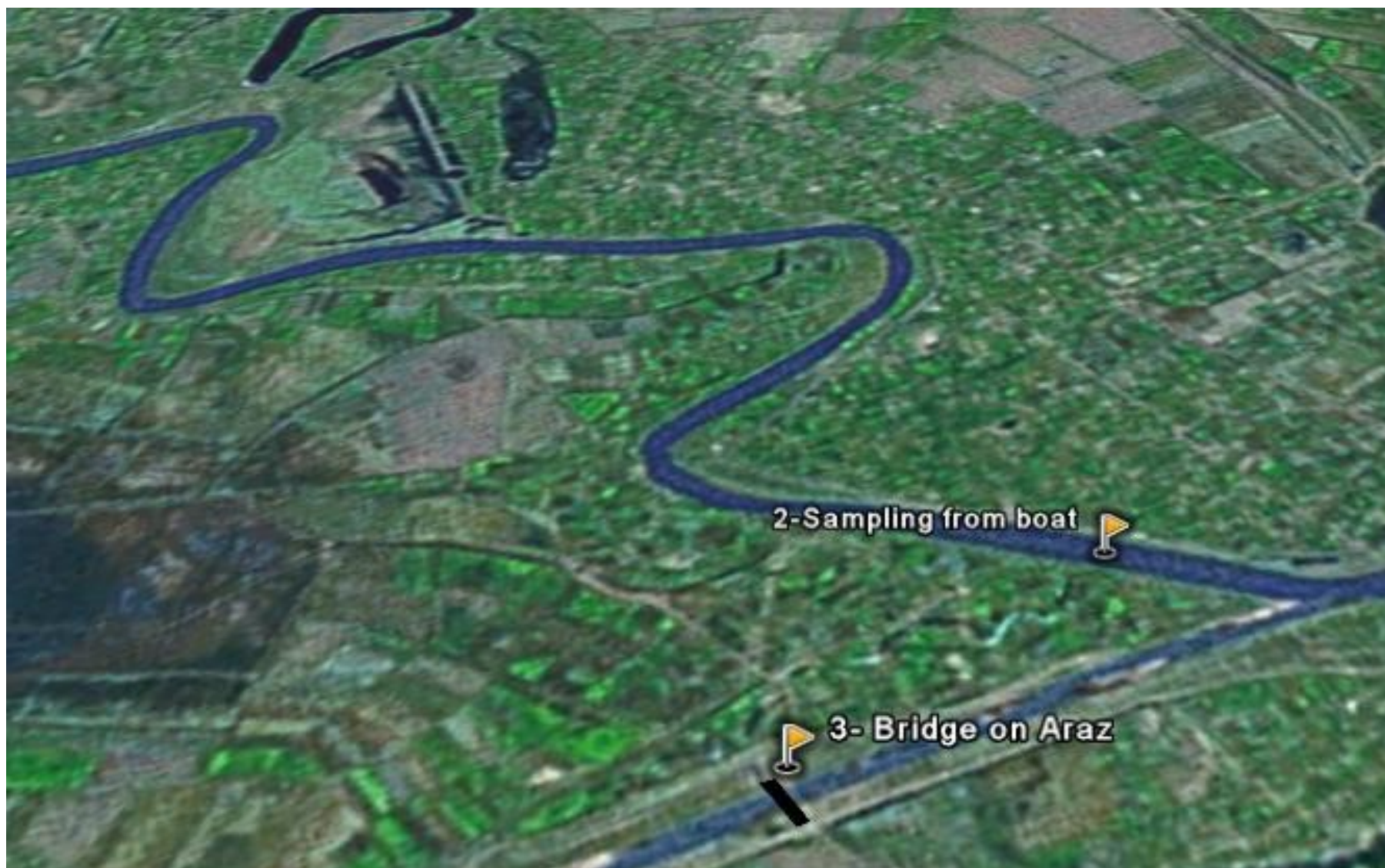


Fig 4 Kuar-Araz Sugovushan sampling points



Fig.5 Kura delta sampling points



Fig.6 Water sampling by using of standard 5 L sampler



Fig.7 Sediment trapping by filtration of river water via 0.45 μ m filter

6 Water quality study

6.1 Samples and sample preparation identifications

As indicated in chapter 2, project were pointed around of study water quality in 7 points of Kura-Araks river system.

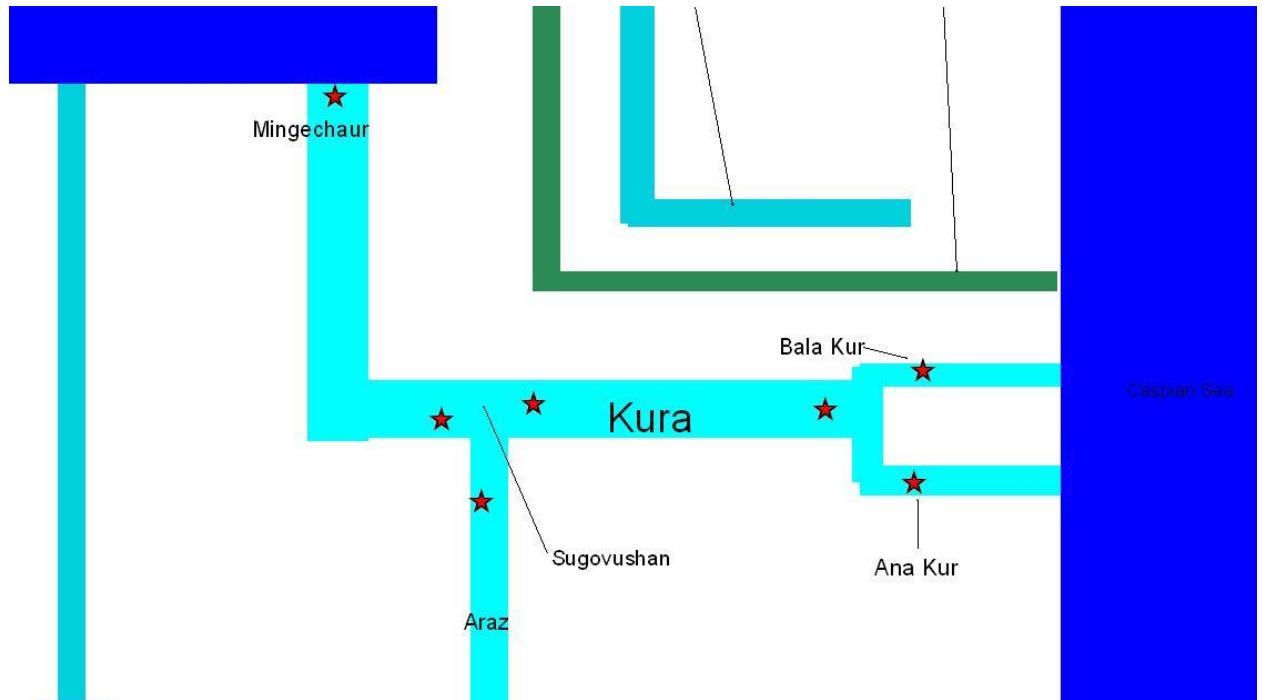


Fig. 4 Water quality study points

Tab. 5 Sampling point description	
St1	After Mingechaur dam. There was planned only 1 sampling from bottom sediment in August and lab analyses
St2	Kura-till Sugovushan (Sabirabad city). There were planned 2 suspended matter sampling in June and August and lab analyses
St3	Araz till Sugovushan (Sabirabad city). There were planned 2 suspended matter sampling in June and August and lab analyses
St4	Kura after Sugovushan (Sabirabad city). There were planned 2 suspended matter sampling in June and August and lab analyses
St5	Kura in Neftchala (Bridge at Banka settlement). There were planned 2 suspended matter sampling in June and August and lab analyses
St6	Ana Kur in Kura delta. There were planned 2 suspended matter sampling in June and August and lab analyses
St7	Bala Kur in Kura delta. There were planned 2 suspended matter sampling in June and August and lab analyses

Thus after June and August sampling Azecolab have 12 suspended matter and 1 bottom sediment samples:

Tab. 6 Sample aliquots and lab tests lists				
Sampling points		Sample amount in g	Dividing for HM and organic tests (g)	List of lab analytical tests
St1 Kura-Mingechaur	June	None		
	August	100	2 40	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
St2 Kura Till-Sugovushan	June	25.70	2 23.70	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
	August	17.38	2 15.38	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
St3 Araz-Till Sugovishan	June	16.81	2 14.81	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
	August	9.21	2 7.21	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
St4 Kura After Sugovushan	June	25.99	2 23.99	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
	August	10.47	2 8.47	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
St5 Kura-Neftchala	June	32.86	2 30.86	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
	August	9.81	2 7.81	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
St6 Ana Kur	June	33.24	2 31.24	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
	August	10.44	2 8.44	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
St7 Bala Kur	June	29.14	2 27.14	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs
	August	9.82	2 7.82	As, Cd, Cu, Hg, Sn 12 EPA PAHs, UNEP Pesticides and PCBs

6.2 Azerbaijan MENR recommended list and UNEP Chemicals

MENR and Rusigar ask Azecolab to provide of the following lab tests on the samples:

Tab. 7 MENR POPs and hazardous lists	
Heavy metals	As, Cd, Cu, Hg, Sn
PAH	Naphthalene, Acenaphthene+Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(ghi)perylene, Indeno(1,2,3-cd)pyrene
Pesticides	Aldrin, Endrin, Dieldrin, Endrin aldehyde, Heptachlor, Heptachlor epoxide, Endosulfan, Endosulfan II, Endosulfan sulfate, a-BHC, b-BHC, d-BHC, g-

	BHC, p,p'-DDD, p,p'-DDE, p,p'-DDT
PCB	PCB-18, PCB-31+28, PCB-52, PCB-44, PCB-101, PCB-149 + PCB-118, PCB-153, PCB-138, PCB-180, PCB-194

Azocolab had tried to compare above list with the UNEP POPs programs requirements. We can find of the following POPs lists from the Guidance for a Global Monitoring Programme for Persistent Organic Pollutants, 1st edition, June 2004, Prepared by UNEP Chemicals, Geneva, Switzerland:

Tab. 8 UNEP POPs list
Aldrin
Chlordane*
Dieldrin
Endrin
Heptachlor
Hexachlorobenzene (HCB)
Mirex
Toxaphene*
Polychlorinated biphenyls (PCB)*
Dichlorodiphenyltrichloroethane (DDT)*
Polychlorinated dibenzo-para-dioxins (PCDD)*
Polychlorinated dibenzofurans (PCDF)*

Substances marked with an asterisk are mixtures of several congeners, for some of them several hundreds. It is not necessary, or even possible, to analyse all these congeners and guidance try to give useful strategies.

Tab. 9 UNEP POPs chemicals description	
Chemical	Analytes
HCB	HCB
Chlordane	<i>cis- and trans-chlordane, cis- and trans-nonachlor, oxychlordane</i>
Heptachlor	Heptachlor, heptachlorepoxide
DDT	4,4'-DDE, 4,4'-DDD, 4,4'-DDT
Mirex	Mirex
Toxaphene	Congeners P26, P50, P62
Dieldrin	Dieldrin
Endrin	Endrin
Aldrin	Aldrin
PCB	Σ PCB ₇ (congeners 28, 52, 101, 118, 138, 153, and 180)
	PCB with TEFs*: (12 congeners: 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 189)
PCDD/PCDF	2,3,7,8-substituted tetra- to octachlorodibenzo- <i>p</i> -dioxins and dibenzofurans (17 congeners)

As we can see in compare of MENR list and UNEP chemical list, Azocolab task list cover:

- almost all UNEP's esticides except Mirex, but involve additionally Endrin aldehyde, Endosulfan, Endosulfan II, Endosulfan sulfate, a-BHC, b-BHC, d-BHC, g-BHC

- All 7 main PCB list and additionally PCB-18, PCB-31, PCB-44, PCB-138, PCB-149, PCB-194
- This project do not involve of the Hexachlorobenzene (HCB), Toxaphene and Dioxine/Furanes

Additionally Azecolab task list covers of the 5 hazardous heavy metals and 16 EPA PAH chemicals.

6.3 Heavy metals

6.3.1 Test results

Tab. 10 Heavy metals results														
	Kura-Mingechaur		Kura Till-Sugovushan		Araz-Till Sugovishan		Kura After Sugovushan		Kura- Neftchala		Ana-Kur		Bala-Kur	
	St1		St2		St3		St4		St5		St6		St7	
	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug
	mg/kg	mg/kg	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
As	ND	2.23	1.92	2.74	12.6	16.3	5.73	6.16	3.16	4.27	3.41	3.98	2.98	4.12
Cd	ND	1.42	0.08	<0.05	0.12	0.08	0.07	0.06	0.07	0.07	<0.05	<0.05	<0.05	<0.05
Cr	ND	57.2	1.93	2.46	2.97	3.61	2.06	2.31	0.81	0.92	0.78	0.84	0.81	0.83
Cu	ND	14.7	1.43	1.67	34.6	42.7	21.4	26.3	8.51	9.38	6.42	7.93	6.91	8.04
Hg	ND	0.04	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Mo	ND	0.12	2.71	3.14	8.29	10.3	4.21	6.13	2.48	3.31	2.22	3.65	2.45	3.66
Ni	ND	3.76	1.72	2.13	4.16	5.52	3.31	4.96	2.91	3.12	3.21	3.41	2.89	3.28
Pb	ND	0.14	<0.7	<0.7	2.31	1.14	0.13	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Zn	ND	2.31	4.12	6.71	37.2	21.3	18.7	13.0	12.9	18.2	15.5	19.7	16.3	19.4

6.3.2 As

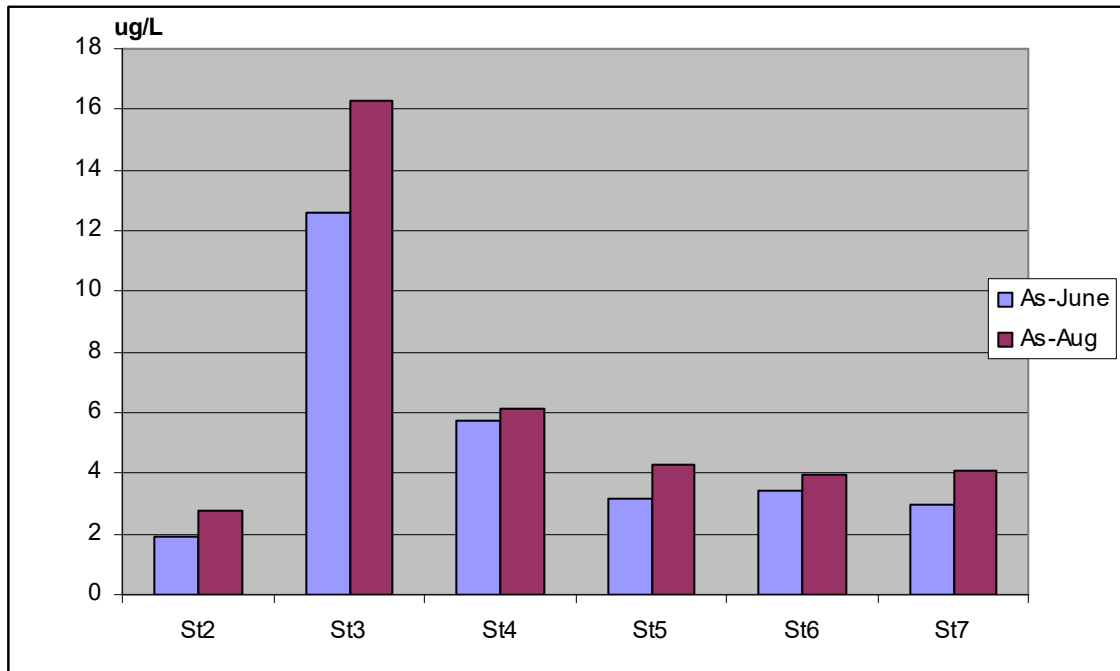


Fig. 5 As pattern in monitored points of Kura-Araks

Maximum Contaminant Level (MCL) for As is 50 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered any data related As content in Kura-Araks water.

Reason may be explained as following:

- Level in water environment was below of the detection limit of monitoring lab of the FSU.

In the meantime we can note of the following data concerning As concentration in US surface waters.

- In US rivers concentration of As vary between 1 to 10 ug/L
- A survey of 293 stations in two nationwide sampling networks on major U.S. rivers found median arsenic levels to be 1 $\mu\text{g/L}$; the 75th percentile level was 3 $\mu\text{g/L}$.
- Arsenic levels in groundwater average about 1–2 $\mu\text{g/L}$, except in some western states with volcanic rock and sulfidic mineral deposits high in arsenic, where arsenic levels up to 3400 $\mu\text{g/L}$ have been observed
- Arsenic has also been detected in rain water at average concentrations of 0.2–0.5 $\mu\text{g/L}$
- Mean concentration of As in Earth crust is 5 mg/kg

Conclusions:

- a) Level of As in each of studied points below of the MCL=50 ug/L
- b) Only for Araks water concentration of As is higher than levels for As encountered in US. (<10 ug/L)
- c) Concentration of As (2.23 mg/kg) in bottom sediments from Kura at Mingechaur city is below of the mean concentration of As at the Earth crust (5 mg/kg)

6.3.3 Cd

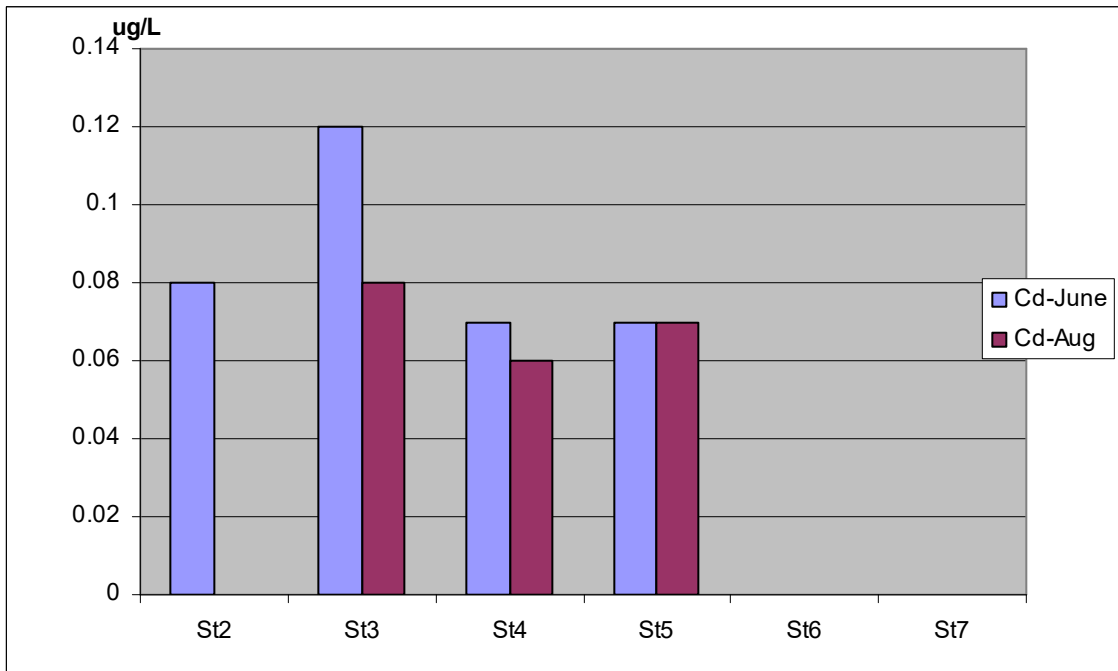


Fig. 6 Cd pattern in monitored points of Kura-Araks

Maximum Contaminant Level (MCL) for Cd is 5 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered any data related As content in Kura-Araks water.

Reason may be explained as following:

- Level in water environment was below of the detection limit of monitoring lab of the FSU.

In the meantime we can note of the following data concerning Cd concentration in US surface waters.

- In a study of the water quality of the Mississippi River and its main tributaries, the U.S. Geological Survey (USGS) found cadmium concentrations ranging from 0.3 to 8 $\mu\text{g/L}$ during July-August 1987; 0.05-0.9 $\mu\text{g/L}$ during November-December 1987; and 0.2-6 $\mu\text{g/L}$ during May-June 1988.
- The cadmium concentration of natural surface water and groundwater is usually less than 1 $\mu\text{g/L}$
- Mean concentration of Cd in Earth crust is 5 mg/kg

Conclusions:

- d) Level of Cd in each of studied points below of the MCL=5 ug/L
- e) Concentration of Cd (1.42 mg/kg) in bottom sediments from Kura at Mingechaur city is below of the mean concentration of As at the Earth crust (5 mg/kg)

6.3.4 Cr

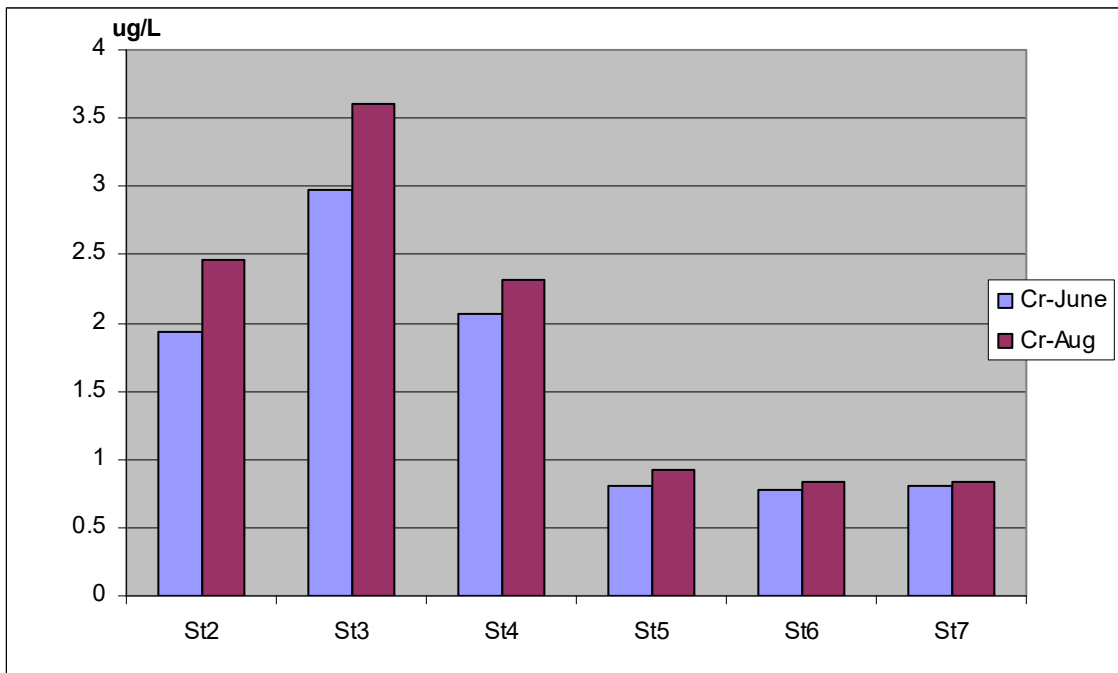


Fig. 7 Cr pattern in monitored points of Kura-Araks

Maximum Contaminant Level (MCL) for Cr is 100 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered any data related Cr content in Kura-Araks water.

In the meantime we can note of the following data concerning Cr concentration in US surface waters.

- Cr concentrations in U.S. river water usually range from <1 to 30 $\mu\text{g/L}$, with a median value of 10 $\mu\text{g/L}$. Chromium concentrations in lake water generally do not exceed 5 $\mu\text{g/L}$.
- Cr levels in groundwater average about 1–8 $\mu\text{g/L}$
- Cr has also been detected in rain water at average concentrations of is 0.14–0.9 $\mu\text{g/L}$
- Mean concentration of Cr in Earth crust is 300 mg/kg

Conclusions:

- f) Level of Cr in each of studied points below of the MCL=100 ug/L
- g) Concentration of Cr (57.2 mg/kg) in bottom sediments from Kura at Mingechaur city is below of the mean concentration of Cr at the Earth crust (300 mg/kg)

6.3.5 Cu

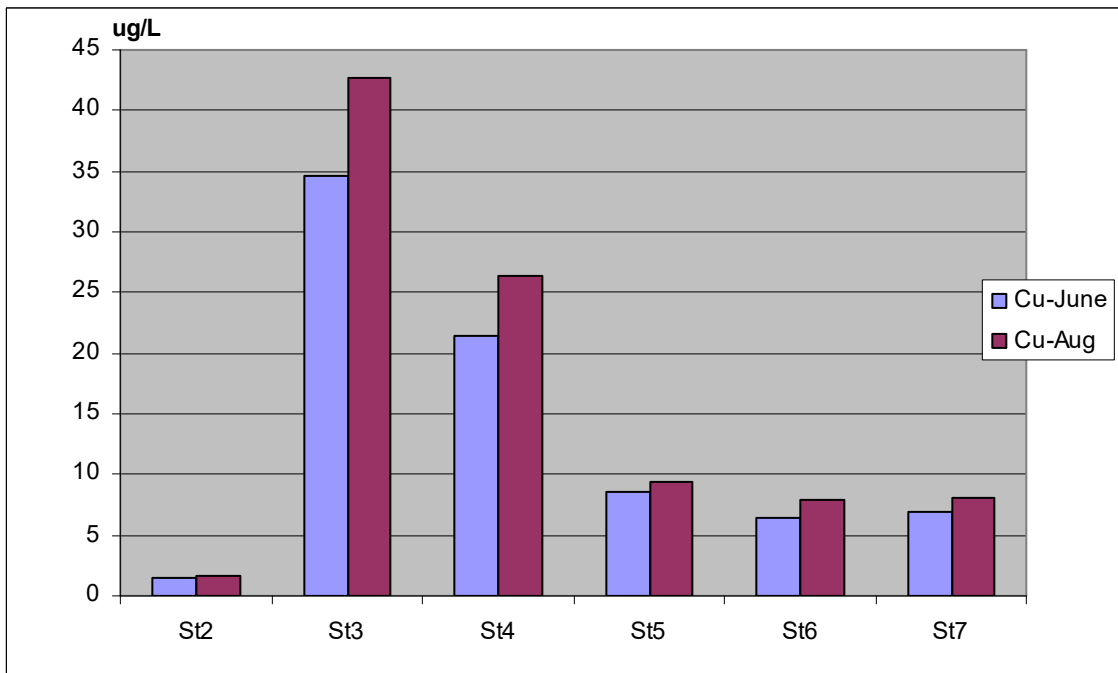


Fig. 8 Cu pattern in monitored points of Kura-Araks

Maximum Contaminant Level (MCL) for Cu is 1300 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered values for Cu between 1-10 ug/L..

In the meantime we can note of the following data concerning Cr concentration in US surface waters.

- Cu concentrations in U.S. river water usually range from <5 to 100 µg/L, with a median value of 10 µg/L.
- Mean concentration of Cu in Earth crust is 100 mg/kg

Conclusions:

- h) Level of Cu in each of studied points below of the MCL=1300 ug/L
- i) Concentration of Cu(14.7 mg/kg) in bottom sediments from Kura at Mingechaur city is below of the mean concentration of Cu at the Earth crust (100 mg/kg)

6.3.6 Hg

We have not fixed Hg in all water samples in frame of lab MDL=0.6 ug/L. Maximum Contaminant Level (MCL) for Hg is 2 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered some values related for Hg between 0.05-1.5 ug/L. And more registration informed about level of Hg below MDL.

In the meantime we can note of the following data concerning Hg concentration in US surface waters.

- Hg concentrations in U.S. river water usually range from <0.01 to 0.1 µg/L
- Concentrations of mercury in rainwater and fresh snow are generally below 0.2 ug/L
- Concentrations of mercury in groundwater usually below 0.01 ug/L
- Mean concentration of Hg in Earth crust is 0.05 mg/kg

Conclusions:

- j) Level of Hg in each of studied points below of the MCL=2 ug/L
- k) Concentration of Hg (0.04 mg/kg) in bottom sediments from Kura at Mingechaur city is below of the mean concentration of Hg at the Earth crust (0.05 mg/kg)

6.3.7 Mo

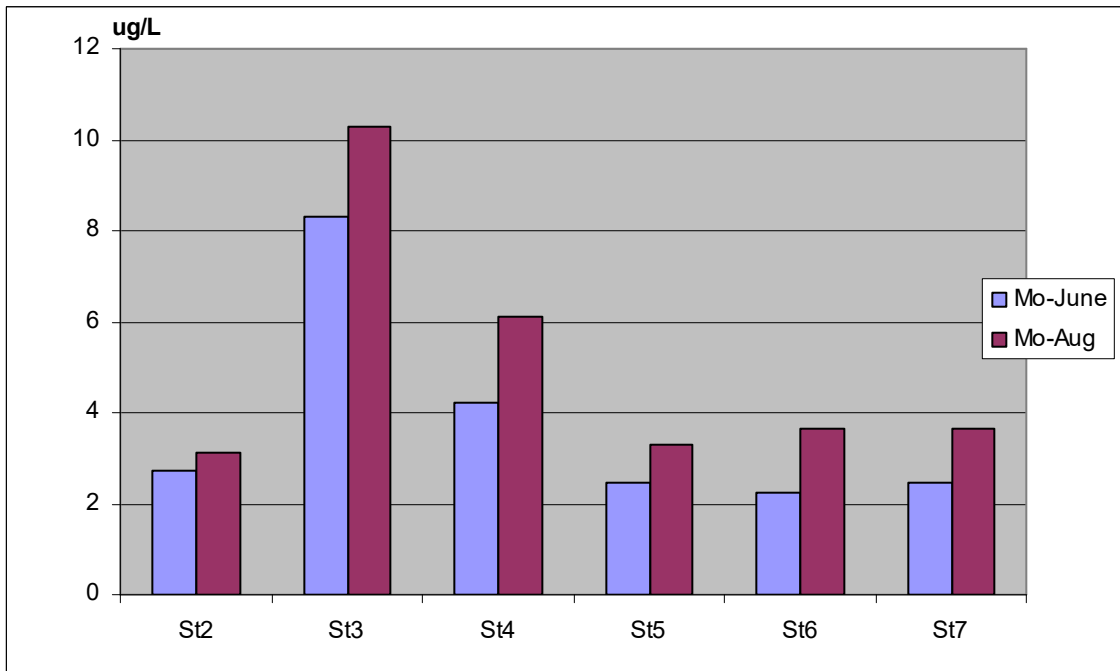


Fig. 9 Ni pattern in monitored points of Kura-Araks

Maximum Contaminant Level (MCL) for Mo is 250 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered some values related for Hg between <MDL till 18 ug/L. And more registration informed about level of Mo below MDL.

In the meantime we can note of the following data concerning Mo concentration in surface waters.

- Mo concentrations in river water usually range from 2 to 10 µg/L

Conclusions:

- 1) Level of Mo in each of studied points below of the MCL=250 ug/L

6.3.8 Ni

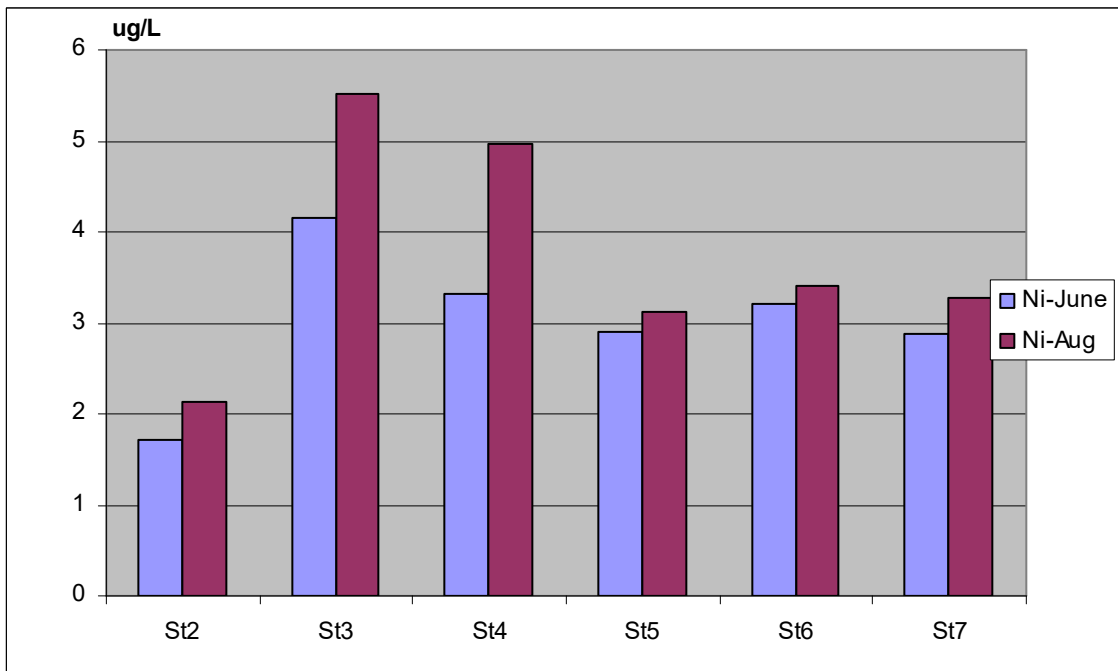


Fig. 10 Ni pattern in monitored points of Kura-Araks

Maximum Contaminant Level (MCL) for Ni is 100 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered values related for Ni below MDL.

In the meantime we can note of the following data concerning Ni concentration in US surface waters.

- Ni concentrations in U.S. river water usually range from 0.1 to 10 µg/L
- Concentrations of Ni in rainwater and fresh snow are generally below 0.3 ug/L
- Concentrations of Ni in groundwater usually below 20 ug/L
- Mean concentration of Ni in Earth crust is 200 mg/kg

Conclusions:

- m) Level of Ni in each of studied points below of the MCL=100 ug/L
- n) Concentration of Ni (3.76 mg/kg) in bottom sediments from Kura at Mingechaur city is below of the mean concentration of Ni at the Earth crust (200 mg/kg)

6.3.9 Pb

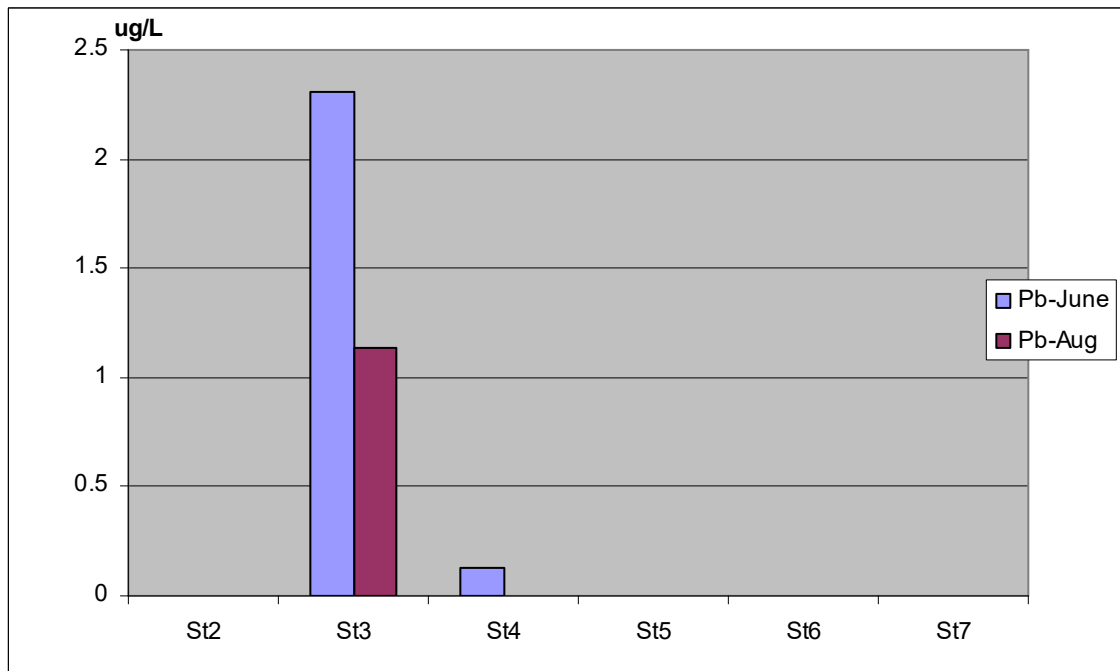


Fig. 11 Pb pattern in monitored points of Kura-Araks

Maximum Contaminant Level (MCL) for Pb is 30 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered values related for Pb below MDL.

In the meantime we can note of the following data concerning Pb concentration in US surface waters.

- Pb concentrations in U.S. river water usually range from 5 to 30 $\mu\text{g/L}$
- Mean concentration of Ni in Earth crust is 16 mg/kg

Conclusions:

- o) Level of Pb in each of studied points below of the MCL=30 ug/L
- p) Concentration of Pb(0.14 mg/kg) in bottom sediments from Kura at Mingechaur city is below of the mean concentration of Pb at the Earth crust (16 mg/kg)

6.3.10 Zn

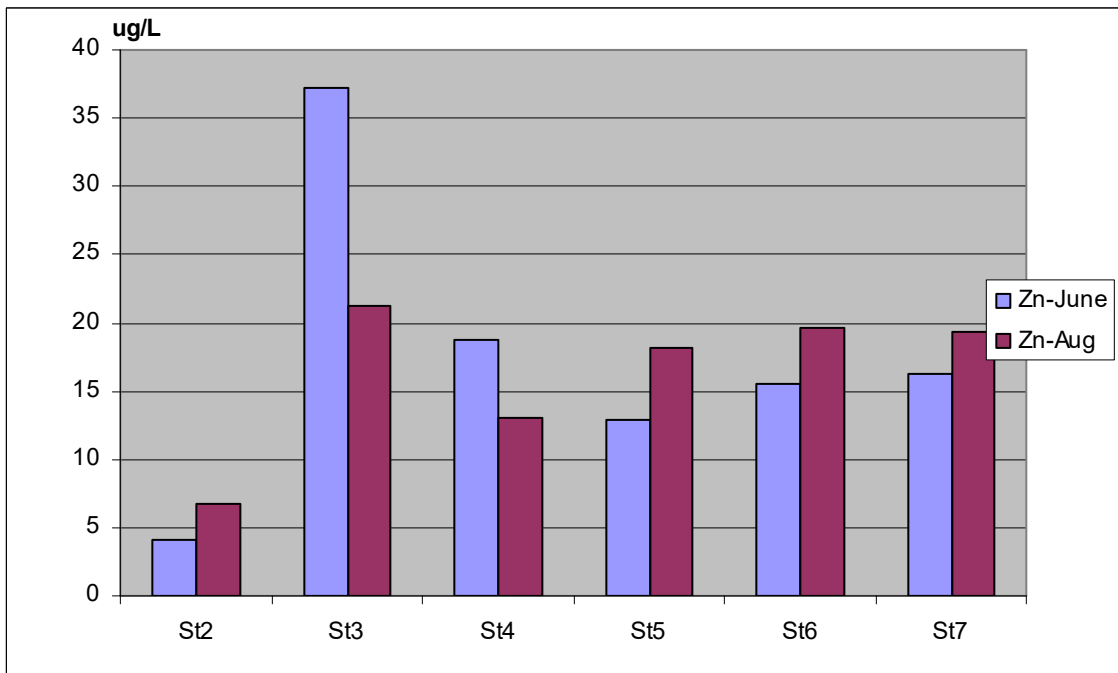


Fig. 12 Pb pattern in monitored points of Kura-Araks

Maximum Contaminant Level (MCL) for Zn is 1000 ug/L. This mean of the highest level of a contaminant that is allowed in drinking water.

Treatment of the Azerbaijan National Hydrometeorology Agencies databases (1980-2000) have discovered values related for Zn between 1 to 20 ug/L..

In the meantime we can note of the following data concerning Zn concentration in US surface waters.

- Zn concentrations in U.S. river water usually range from 3 to 120 $\mu\text{g/L}$
- Mean concentration of Zn in Earth crust is 200 mg/kg

Conclusions:

- q) Level of Zn in each of studied points below of the MCL=1000 ug/L
- r) Concentration of Pb(2.31 mg/kg) in bottom sediments from Kura at Mingechaur city is below of the mean concentration of Pb at the Earth crust (16 mg/kg)

6.4 PAH

Below of the concentration of PAHs compounds determined in sediment samples delivered to chromatography lab.

Tab. 11 PAH compounds test results for trapped suspended matter samples															
		Kura-Mingechaur		Kura Till-Sugovushan		Araz-Till Sugovishan		Kura After Sugovushan		Kura- Neftchala		Ana-Kur		Bala-Kur	
		St1	St1	St2	St2	St3	St3	St4	St4	St5	St5	St6	St6	St7	St7
	MDL	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug
	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
Naphthalene	1.1	ND	2,14	2.27	10.51	<1.1	<1.1	1.15	34.82	<1.1	5.55	<1.1	2.36	<1.1	4.18
Acenaphthene+Fluorene	0.6	ND	4,16	<0.6	1.23	<0.6	<0.6	<0.6	2.23	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Phenanthrene	0.6	ND	0.94	3.41	13.06	0.7	3.3	3.28	29.66	3.01	10.95	2.18	3.17	1.96	2.94
Anthracene	0.1	ND	1.44	<0.1	0.32	<0.1	<0.1	<0.1	0.57	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	0.4	ND	3.12	2.31	4.54	<0.4	1.5	2.15	11.05	1.46	6.94	2.05	3.7	<0.4	5.44
Pyrene	0.6	ND	1.48	<0.6	2.34	<0.6	1.1	<0.6	2.88	1.01	2.92	0.81	0.94	<0.6	1.31
Benzo(a)anthracene	0.4	ND	3.66	4.20	<0.4	0.6	<0.4	1.66	<0.4	2.22	<0.4	1.12	<0.4	0.85	<0.4
Chrysene	0.9	ND	6.17	3.91	9.32	<0.9	1.1	2.03	12.38	1.16	15.32	<0.9	8.42	<0.9	7.81
Benzo(b)fluoranthene	0.5	ND	0.82	1.66	5.49	<0.5	1.2	1.04	8.2	0.64	9.44	<0.5	5.7	0.72	6.93
Benzo(k)fluoranthene	0.4	ND	1.52	0.78	0.42	<0.4	<0.4	<0.4	0.8	<0.4	1.1	<0.4	<0.4	<0.4	0.93
Benzo(a)pyrene	0.3	ND	2.18	0.38	1.13	<0.3	<0.3	<0.3	1.51	<0.3	1.85	<0.3	1.41	<0.3	0.92
Dibenzo(a,h)anthracene	0.3	ND	3.94	35.70	<0.3	4.4	24.9	9.4	<0.3	17.77	<0.3	13.4	<0.3	15	<0.3
Benzo(ghi)perylene	0.6	ND	0.31	0.67	3.49	<0.6	<0.6	<0.6	5.3	<0.6	6.68	<0.6	4.27	<0.6	6.14
Indeno(1,2,3-cd)pyrene	0.4	ND	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Total PAH		ND	25.58	53.02	40.11	5.7	33.1	19.56	72.31	27.27	55.2	19.56	27.61	18.53	32.42
Quant. of sed sam-s (M)	g	100	100	25.7	17.38	16.81	9.21	25.99	10.47	32.86	9.81	33.24	10.44	29.14	9.82
Vol of filtered water (V)	L	ND	ND	53.33	52.75	62.45	58.25	56.79	54.19	55.65	56.34	55.65	59.12	62.8	57.1

To determine of concentration of PAH compounds in water as ng/L, it is possible to use of the following formula:

$$C(\text{ng/L})=N \cdot M/V$$

Where N- concentration of PAHs in trapped sediments in ng/g.

Tab. 12 PAH compounds in Kura-Araks waters															
	MDL ng/g	Kura-Mingechaur		Kura Till-Sugovushan		Araz-Till Sugovishan		Kura After Sugovushan		Kura- Neftchala		Ana-Kur		Bala-Kur	
		St1	St1	St2	St2	St3	St3	St4	St4	St5	St5	St6	St6	St7	St7
		June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug
		ng/g	ng/g	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	1.1	ND	2.14	1.09	3.46	<0.3	<0.17	0.53	6.65	<0.65	0.97	<0.66	0.42	<0.51	0.72
Acenaphthene+Fluorene	0.6	ND	4.16	<0.29	0.41	<0.16	<0.09	<0.27	0.43	<0.35	<0.1	<0.36	<0.11	<0.28	<0.1
Phenanthrene	0.6	ND	0.94	1.64	4.30	0.19	0.52	1.50	5.67	1.78	1.91	1.30	0.56	0.91	0.51
Anthracene	0.1	ND	1.44	<0.05	0.11	<0.03	<0.02	<0.05	0.11	<0.06	<0.02	<0.06	<0.02	<0.05	<0.02
Fluoranthene	0.4	ND	3.12	1.11	1.50	0.11	0.24	0.98	2.11	0.86	1.21	1.22	0.65	<0.19	0.94
Pyrene	0.6	ND	1.48	<0.29	0.77	<0.16	0.17	<0.27	0.55	0.60	0.51	0.48	0.17	<0.28	0.23
Benzo(a)anthracene	0.4	ND	3.66	2.02	<0.13	0.16	<0.06	0.76	<0.08	1.31	<0.07	0.67	<0.07	0.39	<0.07
Chrysene	0.9	ND	6.17	1.88	3.07	<0.24	0.17	0.93	2.37	0.68	2.67	<0.54	1.49	<0.42	1.34
Benzo(b)fluoranthene	0.5	ND	0.82	0.80	1.81	<0.13	0.19	0.48	1.56	0.38	1.64	<0.3	1.01	0.33	1.19
Benzo(k)fluoranthene	0.4	ND	1.52	0.38	0.14	<0.11	<0.06	<0.18	0.15	<0.24	0.19	<0.24	<0.07	<0.19	0.16
Benzo(a)pyrene	0.3	ND	2.18	0.18	0.37	<0.08	<0.05	<0.14	0.29	<0.18	0.32	<0.18	0.25	<0.14	0.16
Dibenzo(a,h)anthracene	0.3	ND	3.94	17.20	<0.1	1.18	3.94	4.30	<0.06	10.49	<0.05	8.00	<0.05	6.96	<0.05
Benzo(ghi)perylene	0.6	ND	0.31	0.32	1.15	<0.16	<0.09	<0.27	1.01	<0.35	1.16	<0.36	0.75	<0.28	1.06
Indeno(1,2,3-cd)pyrene	0.4	ND	<0.4	<0.19	<0.13	<0.11	<0.06	<0.18	<0.08	<0.24	<0.07	<0.24	<0.07	<0.19	<0.07
Quant. of sed sam-s (M)	g	100	100	25.7	17.38	16.81	9.21	25.99	10.47	32.86	9.81	33.24	10.44	29.14	9.82
Vol of filtered water (V)	L	ND	ND	53.33	52.75	62.45	58.25	56.79	54.19	55.65	56.34	55.65	59.12	62.8	57.1

Thus, we using of data from above table (but not for cells marked with yellow) we can compare of the concentration of individual PAHs in various points of river in units of ng/L.

6.4.1 Naphthalene

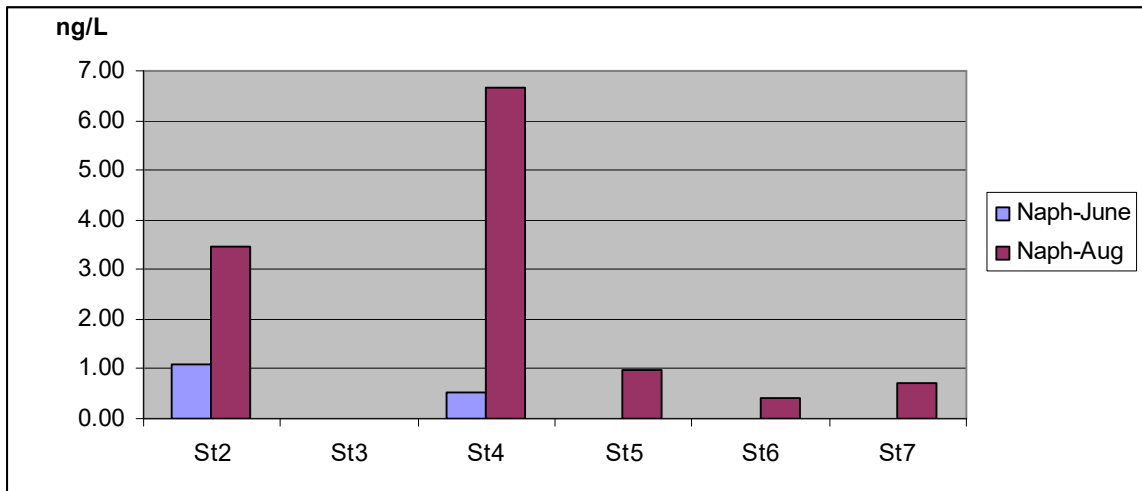


Fig. 13 Naphthalene pattern in monitored points of Kura-Araks

6.4.2 Acenaphthene+Fluorene

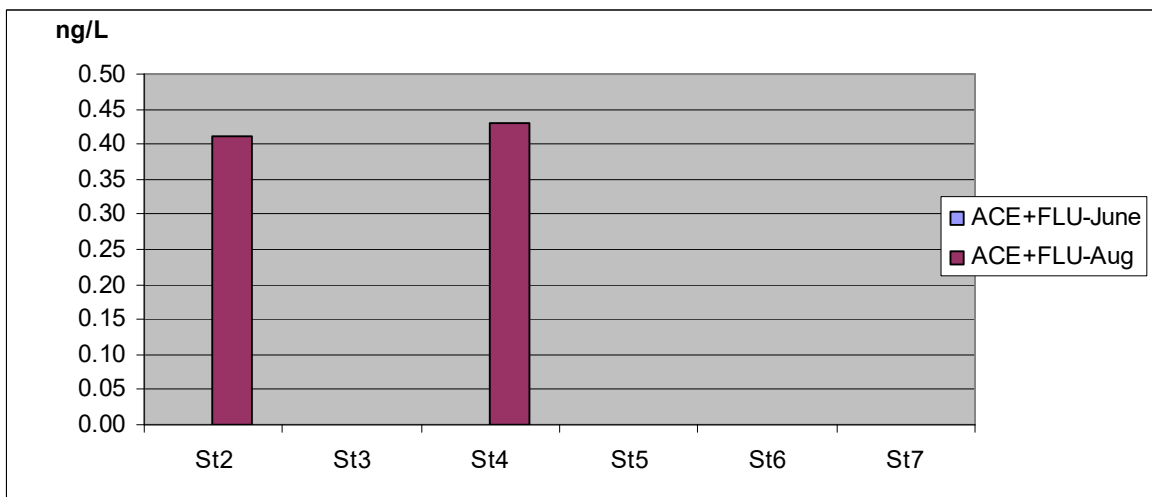


Fig. 14 Acenaphthene+Fluorene pattern in monitored points of Kura-Araks

6.4.3 Phenanthrene

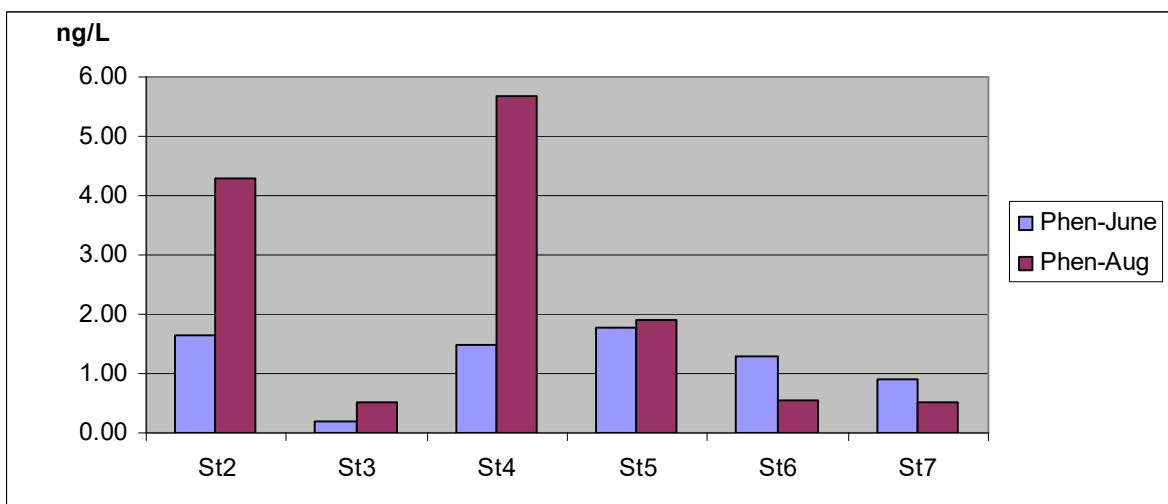


Fig. 15 Phenanthrene pattern in monitored points of Kura-Araks

6.5 Pesticides

Tab. 13 Pesticides concentration in trapped sediment samples															
		Kura-Mingechaur		Kura Till-Sugovushan		Araz-Till Sugovishan		Kura After Sugovushan		Kura- Neftchala		Ana-Kur		Bala-Kur	
		St1	St1	St2	St2	St3	St3	St4	St4	St5	St5	St6	St6	St7	St7
	MDL	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug
	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
Aldrin	0.6	ND	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
a-BHC	0.5	ND	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
b-BHC	0.7	ND	<0.7	2.70	2.79	<0.7	<0.7	3.12	<0.7	2.18	1.04	1.31	<0.7	1.49	1.01
d-BHC	1	ND	<1	<1	<1	<1	<1	<1	<1	<1	1.2	<1	<1	<1	<1
g-BHC	0.6	ND	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
p.p'-DDD	3	ND	<3	4.85	<3	<3	<3	<3	<3	12.55	<3	3.6	<3	4.9	<3
p.p'-DDE	0.5	ND	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
p.p'-DDT	3.9	ND	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	5.88	<3.9	4.2	<3.9	<3.9	<3.9
Dieldrin	0.3	ND	<0.3	1.56	<0.3	0.34	0.39	1.05	<0.3	1.69	<0.3	0.7	<0.3	1.4	<0.3
Endosulfan I	2	ND	<2	<2	<2	<2	<2	<2	<2	<2	2.1	<2	<2	<2	<2
Endosulfan II	0.6	ND	<0.6	0.87	<0.6	<0.6	<0.6	<0.6	<0.6	1.47	<0.6	1.16	<0.6	<0.6	<0.6
Endosulfan sulfate	5	ND	<5	6.60	<5	<5	<5	6.41	<5	13.12	5.2	4.3	2.6	8.1	3.6
Endrin	0.6	ND	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	4.36	1.8	2.94	<0.6	1.68	<0.6	<0.6
Endrin aldehyde	3.7	ND	<3.7	<3.7	<3.7	<3.7	<3.7	<3.7	<3.7	<3.7	<3.7	<3.7	<3.7	<3.7	<3.7
Heptachlor	0.5	ND	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	7	ND	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
Quant. of sed sam-s (M)	g	100	100	25.7	17.38	16.81	9.21	25.99	10.47	32.86	9.81	33.24	10.44	29.14	9.82
Vol of filtered water (V)	L	ND	ND	53.33	52.75	62.45	58.25	56.79	54.19	55.65	56.34	55.65	59.12	62.8	57.1

To determine of concentration of Pesticides compounds in water as ng/L, it is possible to use of the following formula:

$$C(\text{ng/L})=N \cdot M/V$$

Where N- concentration of Pesticides in trapped sediments in ng/g.

Tab. 14 Pesticides concentration in Kura-Araks waters

	MDL	Kura-Mingechaur		Kura Till-Sugovushan		Araz-Till Sugovishan		Kura After Sugovushan		Kura- Neftchala		Ana-Kur		Bala-Kur	
		St1	St1	St2	St2	St3	St3	St4	St4	St5	St5	St6	St6	St7	St7
		June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug
	ng/g	ng/g	ng/g	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Aldrin	0.6	ND	<0.6	<0.29	<0.2	<0.16	<0.09	<0.27	<0.11	<0.35	<0.1	<0.36	<0.11	<0.28	<0.1
a-BHC	0.5	ND	<0.5	<0.24	<0.16	<0.13	<0.08	<0.23	0.21	<0.3	<0.09	<0.3	<0.09	<0.23	<0.09
b-BHC	0.7	ND	<0.7	1.30	0.92	<0.19	<0.11	1.43	<0.13	1.29	0.18	0.78	<0.12	0.69	0.17
d-BHC	1	ND	<1	<0.48	<0.33	<0.27	,0.16	<0.46	<0.19	<0.59	0.21	<0.6	<0.18	,0.46	<0.17
g-BHC	0.6	ND	<0.6	<0.29	<0.2	<0.16	<0.09	<0.27	<0.11	<0.35	<0.1	<0.36	<0.11	,0.28	,0.1
p.p'-DDD	3	ND	<3	2.34	<0.99	,0.81	<0.47	<1.37	<0.57	7.41	<0.52	2.15	<0.53	2.27	<0.52
p.p'-DDE	0.5	ND	<0.5	<0.24	<0.16	<0.13	<0.08	<0.23	<0.1	<0.3	<0.09	<0.3	<0.09	<0.23	<0.09
p.p'-DDT	3.9	ND	<3.9	<1.88	<1.28	<1.05	<0.62	<1.78	<0.75	3.47	<0.68	2.51	<0.69	<1.81	<0.67
Dieldrin	0.3	ND	<0.3	0.75	<0.1	0.09	0.06	0.48	<0.06	1.00	<0.05	0.42	<0.05	0.65	<0.05
Endosulfan I	2	ND	<2	<0.96	<0.66	<0.54	<0.32	<0.92	<0.38	<1.18	0.37	<1.19	<0.35	<0.93	<0.34
Endosulfan II	0.6	ND	<0.6	0.42	<0.2	<0.16	<0.09	<0.27	<0.11	0.87	<0.1	0.69	<0.11	<0.28	<0.1
Endosulfan sulfate	5	ND	<5	3.18	<1.65	<1.35	<0.79	2.93	<0.96	7.75	0.91	2.57	0.46	3.76	0.62
Endrin	0.6	ND	<0.6	<0.29	<0.2	<0.16	<0.09	<0.27	0.83	1.06	0.51	<0.36	0.30	<0.28	<0.1
Endrin aldehyde	3.7	ND	<3.7	<1.78	<1.22	<1	<0.59	<1.69	<0.71	<2.18	<0.64	<2.21	<0.65	<1.72	<0.64
Heptachlor	0.5	ND	<0.5	<0.24	<0.16	<0.13	<0.08	<0.23	<0.1	<0.3	<0.09	<0.3	<0.09	<0.23	<0.09
Quant. of sed sam-s (M)	g	100	100	25.7	17.38	16.81	9.21	25.99	10.47	32.86	9.81	33.24	10.44	29.14	9.82
Vol of filtered water (V)	L	ND	ND	53.33	52.75	62.45	58.25	56.79	54.19	55.65	56.34	55.65	59.12	62.8	57.1

6.6 PCBs

Tab. 15 PCBs concentration in trapped suspended matter samples															
		Kura-Mingechaur		Kura Till-Sugovushan		Araz-Till Sugovishan		Kura After Sugovushan		Kura- Neftchala		Ana-Kur		Bala-Kur	
		St1	St1	St2	St2	St3	St3	St4	St4	St5	St5	St6	St6	St7	St7
	MDL	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug
	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
PCB-18	0.52	ND	2.62	7.25	<0.52	3.44	<0.52	5.17	<0.52	8.82	0.88	3.17	0.68	8.03	1.04
PCB-31+28	0.29	ND	1.16	<0.29	<0.29	<0.29	<0.29	<0.29	0.63	<0.29	0.81	<0.29	<0.29	<0.29	0.41
PCB-52	0.44	ND	0.94	2.87	<0.44	1.15	<0.44	1.28	<0.44	3.87	<0.44	1.42	<0.44	2.18	<0.44
PCB-44	0.3	ND	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
PCB-101	0.29	ND	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	1.93	<0.29	0.68	<0.29	1.07	<0.29
PCB-149 + PCB-118	0.26	ND	0.72	2.78	4.78	<0.26	<0.26	<0.26	13.42	1.66	6.53	1.16	2.81	1.91	4.8
PCB-153	0.23	ND	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	0.32	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23
PCB-138	0.2	ND	0.75	3.98	0.76	1.9	<0.20	2.57	0.69	9.61	1.65	3.19	2.7	7.14	0.49
PCB-180	0.19	ND	0.41	3.45	0.70	<0.19	<0.19	1.11	0.5	<0.19	0.63	<0.19	0.26	<0.19	0.13
PCB-194	0.17	ND	0.39	<0.17	5.18	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Quant. of sed sam-s (M)	g	100	100	25.7	17.38	16.81	9.21	25.99	10.47	32.86	9.81	33.24	10.44	29.14	9.82
Vol of filtered water (V)	L	ND	ND	53.33	52.75	62.45	58.25	56.79	54.19	55.65	56.34	55.65	59.12	62.8	57.1

To determine of concentration of PCBs compounds in water as ng/L, it is possible to use of the following formula:

$$C(\text{ng/L})=N \cdot M/V$$

Where N- concentration of PCBs in trapped sediments in ng/g.

Tab. 16 PCBs in Kura-Araks waters

		Kura-Mingechaur		Kura Till-Sugovushan		Araz-Till Sugovishan		Kura After Sugovushan		Kura- Neftchala		Ana-Kur		Bala-Kur	
		St1	St1	St2	St2	St3	St3	St4	St4	St5	St5	St6	St6	St7	St7
		MDL	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June	Aug	June
	ng/g	ng/g	ng/g	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
PCB-18	0.52	ND	2.62	3.49	<0.17	0.93	<0.08	2.37	<0.1	5.21	0.15	1.89	0.12	3.73	0.18
PCB-31+28	0.29	ND	1.16	<0.14	<0.1	<0.08	<0.05	<0.13	0.12	<0.17	0.14	<0.17	<0.05	<0.13	0.07
PCB-52	0.44	ND	0.94	1.38	<0.14	0.31	<0.07	0.59	<0.08	2.29	<0.08	0.85	<0.08	1.01	<0.08
PCB-44	0.3	ND	<0.30	<0.14	<0.1	<0.08	,0.05	<0.14	<0.06	<0.18	<0.05	<0.18	<0.05	<0.14	,0.05
PCB-101	0.29	ND	<0.29	<0.14	<0.1	<0.08	<0.05	<0.13	,0.06	1.14	<0.05	0.41	<0.05	0.50	<0.05
PCB-149 + PCB-118	0.26	ND	0.72	1.34	1.57	<0.07	<0.04	<0.12	2.56	0.98	1.14	0.69	0.50	0.89	0.83
PCB-153	0.23	ND	<0.23	<0.11	<0.08	<0.06	<0.04	<0.11	0.06	<0.14	<0.04	<0.14	<0.04	<0.11	<0.04
PCB-138	0.2	ND	0.75	1.92	0.25	0.51	<0.03	1.18	0.13	5.67	0.29	1.91	0.48	3.31	0.08
PCB-180	0.19	ND	0.41	1.66	0.23	<0.05	<0.03	0.51	0.10	<0.11	0.11	,0.11	0.05	<0.09	0.02
PCB-194	0.17	ND	0.39	<0.08	1.71	<0.05	<0.03	<0.08	<0.03	<0.1	<0.03	<0.1	<0.03	<0.08	<0.03
Quant. of sed sam-s (M)	g	100	100	25.7	17.38	16.81	9.21	25.99	10.47	32.86	9.81	33.24	10.44	29.14	9.82
Vol of filtered water (V)	L	ND	ND	53.33	52.75	62.45	58.25	56.79	54.19	55.65	56.34	55.65	59.12	62.8	57.1

7 Estimated transportation of pollutants

To assess of quantity of transported pollutant we need accurate data both concerning water flow and concentration of chemicals.

Current study may be 1st attempt to collect of accurate data concerning concentration of POPs chemicals in Kura waters.

7.1 Water flow data

At the moment is available only official water flow data concerning 2003 which cover only 4 studied project stations.

2003	Kura	Kura	Araz	Kura
m3/sec	Mingechaur	Till Sugovushan	Till Sugovushan	Surra
June	81	102	162	412
Avg	157	156	27	218

7.2 Example of calculation of transported pollutants

Azocolab can not consider use collected preliminary POPs data to develop of mass transported modelling. Such approach require long-term monitoring to receive reliable set of data.

But, we can make attempt for test of such type assessment.

By multiplication of concentration of chemicals to the volume of water passed through of cross-section of station it is possible to assess of amount of each transported chemicals.

E.g. we can calculate transported PCB-18 through each of above 4 station during 1 monthes as following:

		Kura	Kura	Araz	Kura
kg/monthes		Mingechaur	Till Sugovushan	Till Sugovushan	Surra
PCB-18	June	0.73	0.25	1.00	5.57
PCB-18	Aug	<0.07	<0.03	<0.01	0.08

Thus, we can expect transport approximately 5.57 kg of PCB-18 monthly through Surra station (after Sabirabad) toward Caspian Sea. Or we can say that the monthly amount of PCB-18 goes through Evlakh city expected to be below 30-70 g.

Next, we can expect approximately 1 kg transportation of Dieldrin through Surra in direction of Caspian sea monthly.

		Kura	Kura	Araz	Kura
kg/monthes		Mingechaur	Till Sugovushan	Till Sugovushan	Surra
Dieldrin	June	0.16	<0.02	0.20	1.07
Dieldrin	Aug	<0.04	<0.02	<0.008	0.03

8 Test methods

8.1 Heavy metals

Sample preparation. Aliquots of approximately 0.25 g of samples were weighed into acid-cleaned TFM vessels and digested with mixture 6 ml of nitric, 2 ml of hydrochloric and 3 ml hydrofluoric acid in microwave oven (Milestone Ethos plus with HPR –1000/10S high pressure rotor) operated with following microwave run program:

Step	Time(minutes)	Temperature	Microwave power
1	4	40°C	Up to 1.000 Watt
2	4.30	90°C	Up to 1.000 Watt
3	4.30	190°C	Up to 1.000 Watt
4	7	220°C	Up to 1.000 Watt
5	20	220°C	Up to 1.000 Watt

After dissolution, the vessel were cooled to room temperature and the solution transferred to pre-conditioned polythene vials, made up to 50 ml with deionised water.

Solvent used: Nitric acid -65% , Hydrochloric acid -37% and Hydrofluoric acid - 40 %.

Trace metals were determined by AAS 220 FS+GTA 110+VGA 77 firma Varian and AAS AAnalyst 800 with Zeeman corrector firma PerkinElmer.

Element	Apparatus (type)	Atomizer (type)	Background corrector(type e)	Modifier
As	AAS –220 FS	Electrothermal	Deuterium lamp	5 µg Pd+3µg Mg(NO) ₃
Cd	AAS- AAnalst 800	Electrothermal	Zeeman corrector	50 µg NH ₄ H ₂ PO ₄ +3µg Mg(NO) ₃
Cr	AAS –220 FS	Electrothermal	Deuterium lamp	15 µg Mg(NO) ₃
Cu	AAS –220 FS	Flame	Deuterium lamp	Non
Hg	AAS –220 FS	VGA 77	Deuterium lamp	Non
Ni	AAS- AAnalst 800	Electrothermal	Zeeman corrector	Non
Pb	AAS- AAnalst 800	Electrothermal	Zeeman corrector	50 µg NH ₄ H ₂ PO ₄ +3µg Mg(NO) ₃
Zn	AAS –220 FS	Flame	Deuterium lamp	Non

Calculation of results:

$$\text{Element(mg/kg)} = [\text{mg/L in sample solution}] \times [\text{sample volume in ml}] \times [\text{d.f}] / \text{sample weight in g.}$$

Where (d.f) = dilution factor, if used

8.2 Methods used for determination of Petroleum Hydrocarbons and PAH

Description of METHODS USED: METHOD FOR THE DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS (EPH)- MADEP-EPH-98-1, January 1998. (Revision 0). For PAH determination with HPLC FLD was used method EPA 8310. Cleanup was carried out using METHOD EPA -3630C (Silica gel cleanup).

(if following a published procedure, please, summarise the method in the allocated spaces and attach a copy of the relevant paper)

Data corrected for moisture content: YES

Extraction procedure:

A sample was analyzed by method "MADEP-EPH-98-1". First of all it was extracted with methylene chloride in Soxhlet extractor during 20 hours, then was concentrated in Kuderna-Danish apparatus to 10 ml, dried over sodium sulfate, solvent exchanged into hexane, and concentrated in a Kuderna-Danish apparatus to 1mL.

Solvent used: methylene chloride, hexane, acetone, cyclohexane, pentane, acetonitrile

Internal standards used: Not used.

Clean-up procedure:

Sample cleanup and separation into aliphatic and aromatic fractions were conducted on silica gel columns (5g of activated silica gel with 1-2cm of anhydrous sodium sulfate on top) using hexane for aliphatic fraction and methylene chloride for aromatic fraction. The two eluted solutions are then re-concentrated to final volumes of 1 mL each (i.e., an aliphatic fraction and an aromatic fraction). The aliphatic fraction is then analyzed by GC/FID.

4mL of cyclohexane was added to the aromatic fraction solution. Then the solution was concentrated to 1-2mL on Kuderna-Danish apparatus. Then cleanup was carried out by the METHOD 3630C SILICA GEL CLEANUP (see part 7.2.1).

A slurry of 10g of activated silica gel in methylene chloride was prepared and placed into a 10 mm ID chromatographic column. 1 to 2 cm of anhydrous sodium sulfate was added to the top of the silica gel. 40mL of pentane were used for pre-elution of column. The rate for all elutions was about 2mL/min. The eluate was discarded and, just prior to exposure of the sodium sulfate layer to the air, the 2 mL cyclohexane sample extract was transferred onto the column using an additional 2mL cyclohexane to complete the transfer. Just prior to exposure of the sodium sulfate layer to the air, 25 mL of pentane was added and the elution of the column continued. This pentane eluate was discarded. The elution of the column was continued with 25 mL of methylene chloride/pentane (4:6)(v/v) into a flask for concentration. The collected fraction was concentrated in Kuderna- Danish to 1-10 mL. 4mL of acetonitrile were added to the extract in the concentrator tube. The solvent was concentrated on Kuderna-Danish apparatus with water bath temperature at 95-100°C. The extract volume was adjusted to 1.0mL. The extract then was analyzed by HPLC/FLD.

Fractionation procedure:

Columns of activated silica gel were used for silica gel cleanup and fractionation. The column rinsed with 30mL of hexane. 1.0 mL of sample extract was loaded onto the column. The eluant was immediately collected in a 25-mL volumetric flask labeled "aliphatics". The column was eluted with approximately 19 mL more hexane, so that a total of approximately 20 mL of hexane was passed through the column.

Following recovery of the aliphatic fraction, the column was eluted with 20 mL of methylene chloride and the eluant collected in a 25 mL volumetric flask. This fraction was labeled "aromatics".

Calculation of results: (please, give example of calculations with units)

The following formula was used for calculation of concentrations of analyzed compounds in the samples:

$$C_{sample} \left[\frac{ng}{g} \right] = \frac{C_{extract} \left[\frac{\mu g}{L} \right] \cdot V_{extract} [mL] - C_{blank} \left[\frac{\mu g}{L} \right] \cdot V_{blank} [mL]}{M_{sample} [g]} \times \frac{100}{100 - W[\%]} \times DF$$

Where:

C_{sample} – concentration of analyzed compound in sample, ng/g;

$C_{extract}$ – concentration of analyzed compound in sample extract, $\mu\text{g/L}$;

C_{blank} – concentration of analyzed compound in blank extract, $\mu\text{g/L}$;

$V_{extract}$ – volume of sample extract, mL;

V_{blank} – volume of blank extract, mL;

M_{sample} – mass of sample taken for extraction, g;

W – moisture content of sample, %;

DF – dilution factor, which is used only if sample extract was diluted prior to injection.

Note: $C_{extract}$ and C_{blank} are calculated by chromatogram processing software on the base of calibration curves

Example: For Benzo(a)pyrene in reference sample IAEA-408 Sediment Sample

$C_{extract} = 7.82 \mu\text{g/L}$;

$C_{blank} = 0 \mu\text{g/L}$;

$V_{extract} = 1.8 \text{ mL}$;

$V_{blank} = 1.1 \text{ mL}$;

$M_{sample} = 5.4142 \text{ g}$;

$W = 1.65 \%$;

$DF = 20$

$$C_{sample} \left[\frac{\text{ng}}{\text{g}} \right] = \frac{7.82 \left[\frac{\mu\text{g}}{\text{L}} \right] \cdot 1.8 [\text{mL}] - 0 \left[\frac{\mu\text{g}}{\text{L}} \right] \cdot 1.1 [\text{mL}]}{5.4142 [\text{g}]} \times \frac{100}{100 - 1.65 [\%]} \times 20 = 52.87 \left[\frac{\text{ng}}{\text{g}} \right]$$

Tab. 20 HPLC CONDITIONS for PAHs		
Apparatus (type):	ProStar (Varian, USA)	
Detector (type)	FLD	
Injection technique:	Manual	
Column Termostate temperature:	30°C	
Injection volume:	20 μl	
Carrier Solvents:	Acetonitrile/Water	
Column (type):	Chrompack CromSpher PAH (Varian CP29376)	
length:	250 mm	
int. diam.:	4.6 mm	
stationary phase:	CromSpher PAH	
Typical particle size:	5 μm	
Flow programme:		
Flowrate:	1.0 ml/min	
Initial Ratio:.	Acetonitrile 70% / Water 30% for 2 min.	
1 st rate:	1.5 $\% \cdot \text{min}^{-1}$ to Acetonitrile 100% / Water 0%	
isocratic:	Acetonitrile 100% / Water 0% for 20	

	min.	
Recorder/Integrator (type):	Personal Computer with Star Chromatography Workstation Version 6.0	

8.3 Methods used for determination of Pesticides and PCB

Description of METHODS USED: EPA METHODS 8081A, 8082, 3540, 3620

Solid samples were extracted with methylene chloride-acetone (1:1) using Method 3540 (Soxlet extraction). After cleanup, the extract was analyzed by injecting a 1- μ L sample into a gas chromatograph with capillary column and electron capture detector (GC/ECD).

Data corrected for moisture content: YES

Extraction procedure:

Solid samples were extracted with methylene chloride -acetone (1:1) using Method 3540 (Soxlet extraction) during 20 hours.

Extracts were concentrated in Kuderna-Danish apparatus. After extracts were dried in column with sodium sulfate. Extracts solvent was exchanged to hexane. Then samples were cleaned up by Florisil. Method EPA 3620 (florisil) was used to separate organochlorine pesticides and PCBs from aliphatic compounds, aromatics, and nitrogen-containing compounds.

Solvent used: methylene chloride, hexane, acetone, ethyl ether and ethyl alcohol (for removal of peroxides is provided with the test strips. After cleanup, 20 mL of ethyl alcohol preservative must be added to each liter of ether.)

Internal standards used: Not used.

Clean-up procedure:

Florisil column cleanup: 20g of Florisil were into a chromatographic column. The column taped to settle the Florisil and 1-2 cm of anhydrous sodium sulfate added to the top. 60 mL of hexane was added to wet and rinse the sodium sulfate and Florisil. The sample extract volume was adjusted to 10 mL with hexane and transferred from the K-D concentrator tube onto the column. The tube was rinsed twice with 1-2 mL of hexane, adding each rinse to the column. The column was eluted with 200 mL of 6% ethyl ether in hexane (V/V) (Fraction 1) at a rate of about 5 mL/min. Then the column was eluted again, using 200 mL of 15% ethyl ether in hexane (V/V) (Fraction 2). The third elution was performed using 200 mL of 50% ethyl ether in hexane (V/V) (Fraction 3). The fractions were concentrated in Kuderna-Danish apparatus. For remove sulfur influence, in cleanup procedure was used copper powder. Then the volume of extracts was adjusted to 1mL and analyzed by GC/ECD.

Fractionation procedure: see cleanup procedure.

Tab. 21 GAS CHROMATOGRAPHIC CONDITIONS for Pesticides and PCBs		
Apparatus (type):	GC CP3800 Varian (USA)	
Detector (type)	ECD	
Injection technique:	AutoSampler CP-8410	
Injection temperature	300°C	
Injection volume:	1 μ l	
(Splitter closing time):	Min	
Carrier gas (H ₂ , He,N ₂):	N ₂	
Carrier gas flow:	3 ml/min.	
Split ratio (in case of splitted injection):		
Column (type):	Chrompack CP-Sil 8CB Varian CP7771	
length:	50 m	

int. diam.:	0.32 mm	
stationary phase:	5% phenyl, 95% dimethyl polysiloxane	
(film thickness):	1.2 µm	
Temperature programme:		
initial temp.:	150 °C for 5 min.	
1 st rate:	5 °C.min ⁻¹ to 300 °C	
isothermal:	300 °C for 5 min.	
Detector temperature:	320 °C	
Detector “make-up” gas:	N ₂	
make-up flow:	25.cm ³ .min ⁻¹	
*Air flow:	cm ³ .min ⁻¹	
*Hydrogen flow:	cm ³ .min ⁻¹	
Recorder/Integrator (type):	Personal Computer with Star Chromatography Workstation Version 6.0	

Calculation of results: (please, give example of calculations with units)

The following formula was used for calculation of concentrations of analyzed compounds in the samples:

$$C_{sample} \left[\frac{ng}{g} \right] = \frac{C_{extract} \left[\frac{\mu g}{L} \right] \cdot V_{extract} [mL] - C_{blank} \left[\frac{\mu g}{L} \right] \cdot V_{blank} [mL]}{M_{sample} [g]} \times \frac{100}{100 - W[\%]} \times DF$$

Where:

C_{sample} – concentration of analyzed compound in sample, ng/g;

$C_{extract}$ – concentration of analyzed compound in sample extract, µg/L;

C_{blank} – concentration of analyzed compound in blank extract, µg/L;

$V_{extract}$ – volume of sample extract, mL;

V_{blank} – volume of blank extract, mL;

M_{sample} – mass of sample taken for extraction, g;

W – moisture content of sample, %;

DF – dilution factor, which is used only if sample extract was diluted prior to injection.

Note: $C_{extract}$ and C_{blank} are calculated by chromatogram processing software on the base of calibration curves

Example: For p,p'-DDE in sediment sample

$C_{extract} = 19.21 \mu g/L$;

$C_{blank} = 0 \mu g/L$;

$V_{extract} = 1.9 \text{ mL}$;

$V_{blank} = 2.0 \text{ mL}$;

$M_{sample} = 7.3088 \text{ g}$;

$W = 0.82 \%$;

$DF = 1$

$$C_{sample} \left[\frac{ng}{g} \right] = \frac{19.21 \left[\frac{\mu g}{L} \right] \cdot 1.9 [mL] - 0 \left[\frac{\mu g}{L} \right] \cdot 2.0 [mL]}{7.3088 [g]} \times \frac{100}{100 - 0.82 [\%]} \times 1 = 5.035 \left[\frac{ng}{g} \right]$$

9 Historical data

Azocolab had treated of the published data of previous Agency named Azerbaijan State Hydrometeorology Agency. These data covered 1980-2000.

Full treated data are represented in the attached Excel file: Kura-AzHydroMet(1980-2000).

Studying of that data of the following conclusions could be made:

- There were not high quality equipments and related quality control procedures
- Data was collected non-systematically, both for stations and months
- From these project tasks only data for some of heavy metals could be discovered there (Hg, Cu, Zn). For other chemicals you can find either <MDL (without determined, what is value of MDL) or empty cell.
- PAHs, Pesticides and PCBs were not involved into the list of chemicals to control by lab of State Hydrometeorology Agency during 1980-2000.

At 1997-1998 Tacis had initiated of studying process of environmental lab in Azerbaijan.

Working group by leading of Dr Ian Webber had investigated of all related lab practice:

- concerning adequate of using equipments
- concerning adequate of using reagents and standards
- methods and personnel trainings
- Quality control and Quality assurance issues

History of formation of Azocolab is directly connected with results of Dr Ian Webber's group.

Azocolab was formed to satisfy of international lab practice requirements:

- to use modern equipment
- to use certified reagents and standards
- to apply international approved methods and adequate personnel trainings
- Implementation quality control and quality assurance practice

Thus, it was not efficiently to refer for data generated by previous Azerbaijan State Hydrometeorology Agency lab, because they have not sufficiently finance for appropriate lab activity.

As example we can annex some data for a few metals (Cu, Hg, Pb, Zn) from their "annual bulletin" to see process type. As noted, all data from Azerbaijan State Hydrometeorology Agency's bulletins are collected in additional Excel file "Kura-AzHydroMet(1980-2000)".

Tab. 23 Cu during 1980-2000- Mingeclair

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	Mingeclair-below than city	Cu	ug/L	5	5				2	3	6	7	4	5	4
1981	Mingeclair-below than city	Cu	ug/L	6	4								5	4	5
1982	Mingeclair-below than city	Cu	ug/L	3	1	2	1	5	2	3	2	10	9	8	8
1983	Mingeclair-below than city	Cu	ug/L	5	3	2	4	6	2	3	8	10	6	3	8
1984	Mingeclair-below than city	Cu	ug/L	6	5	5	5	2	3	10	9	10	7	6	5
1985	Mingeclair-below than city	Cu	ug/L	4	4	6	6	6	3	4.1	4	6	6	6	7
1986	Mingeclair-below than city	Cu	ug/L	6	5	5	7	4	10	13	6	2	7	15	8
1988	Mingeclair-below than city	Cu	ug/L	11	12	11	8	10	9	3	7	7	6	10	9
1989	Mingeclair-below than city	Cu	ug/L	12	15	13	13	9	12	11	14	10			
1990	Mingeclair-below than city	Cu	ug/L		10		6			7			4		
1991	Mingeclair-below than city	Cu	ug/L												
1992	Mingeclair-below than city	Cu	ug/L	9	7	8	12			8			13		
1993	Mingeclair-below than city	Cu	ug/L		14		6			8			3		
1994	Mingeclair-below than city	Cu	ug/L		4		7			7			8		
1995	Mingeclair-below than city	Cu	ug/L		6		7			6	5		2		
1996	Mingeclair-below than city	Cu	ug/L		4		3	5		12			4		
1997	Mingeclair-below than city	Cu	ug/L	4	5			5	6		3		5	5	
1998	Mingeclair-below than city	Cu	ug/L				2						3		
1999	Mingeclair-below than city	Cu	ug/L			7			8		7		7		
2000	Mingeclair-below than city	Cu	ug/L	2			3		4	9	8	7	8	5	7

Tab. 24 Cu during 1980-2000- Evlakh

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	Evlakh	Cu ug/L	6					6		5		7		6
1981	Evlakh	Cu ug/L		4							8		6	
1982	Evlakh	Cu ug/L		2		1		4		3		4		2
1983	Evlakh	Cu ug/L		1		4		3		5		3		4
1984	Evlakh	Cu ug/L		5		4		4		7		3		6
1985	Evlakh	Cu ug/L		4		4		4		4		7		8
1986	Evlakh	Cu ug/L		2		6	4	8	12	3	2	5		3
1988	Evlakh	Cu ug/L		9		7		5		6		4		7
1989	Evlakh	Cu ug/L		5		3		5		7		4		6
1990	Evlakh	Cu ug/L		6		13			7			3		
1991	Evlakh	Cu ug/L		7		9		10		2		6		5
1992	Evlakh	Cu ug/L		6		4		8				7		
1993	Evlakh	Cu ug/L		6		16			7			2		
1994	Evlakh	Cu ug/L		2		7			7			6		
1995	Evlakh	Cu ug/L		4		5								
1996	Evlakh	Cu ug/L		3					3			2		
1997	Evlakh	Cu ug/L		3						2				
1998	Evlakh	Cu ug/L				3						2		
1999	Evlakh	Cu ug/L												
2000	Evlakh	Cu ug/L							3				2	5

Tab. 25 Cu during 1980-2000- N.-E.Bankh-below

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	N.-E.Bankh-below	Cu	ug/L											
1981	N.-E.Bankh-below	Cu	ug/L											
1982	N.-E.Bankh-below	Cu	ug/L			1		4	6		5			3
1983	N.-E.Bankh-below	Cu	ug/L		2		7	3		11		5		3
1984	N.-E.Bankh-below	Cu	ug/L							7		5	5	5
1985	N.-E.Bankh-below	Cu	ug/L		6		4	7	7	6		9	6	
1986	N.-E.Bankh-below	Cu	ug/L	6	12		7	6		4		10		8
1988	N.-E.Bankh-below	Cu	ug/L		12		9		15	6		8		9
1989	N.-E.Bankh-below	Cu	ug/L		15		11	10		13		10		7
1990	N.-E.Bankh-below	Cu	ug/L		4		8		7			3		
1991	N.-E.Bankh-below	Cu	ug/L		7		6	9		11		15		8
1992	N.-E.Bankh-below	Cu	ug/L		4		13		6			6	7	
1993	N.-E.Bankh-below	Cu	ug/L		5		8		8			2		
1994	N.-E.Bankh-below	Cu	ug/L		5		4		4			3		
1995	N.-E.Bankh-below	Cu	ug/L		5		5		3			2		
1996	N.-E.Bankh-below	Cu	ug/L		4		6		9			7		
1997	N.-E.Bankh-below	Cu	ug/L		5		5	6	6	4	6	7	4	
1998	N.-E.Bankh-below	Cu	ug/L		4	4	5		3					
1999	N.-E.Bankh-below	Cu	ug/L		3		4		6			6		
2000	N.-E.Bankh-below	Cu	ug/L	3	4	4	5	3	5	6	4	7	3	8

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	N.-E.Bankh-below	Zn	ug/L											
1981	N.-E.Bankh-below	Zn	ug/L											
1982	N.-E.Bankh-below	Zn	ug/L											
1983	N.-E.Bankh-below	Zn	ug/L		6		9	6		8		12		6
1984	N.-E.Bankh-below	Zn	ug/L										7	5
1985	N.-E.Bankh-below	Zn	ug/L		3		7		3	4	4	6	4	
1986	N.-E.Bankh-below	Zn	ug/L	2	4		2		1		4	13		10
1988	N.-E.Bankh-below	Zn	ug/L		8		6		7		4	5		4
1989	N.-E.Bankh-below	Zn	ug/L		8		3		6		9	6		3
1990	N.-E.Bankh-below	Zn	ug/L		4		3			6		5		
1991	N.-E.Bankh-below	Zn	ug/L		8		4		5		13	10		5
1992	N.-E.Bankh-below	Zn	ug/L		3		8			9		2	4	
1993	N.-E.Bankh-below	Zn	ug/L		3		3			5		5		
1994	N.-E.Bankh-below	Zn	ug/L		4		3			4		2		
1995	N.-E.Bankh-below	Zn	ug/L		4		3			2		3		
1996	N.-E.Bankh-below	Zn	ug/L		3		5			6		5		
1997	N.-E.Bankh-below	Zn	ug/L		4		4			4	3	5	3	
1998	N.-E.Bankh-below	Zn	ug/L		3	3	4			2		3		
1999	N.-E.Bankh-below	Zn	ug/L		4		5			4		3		
2000	N.-E.Bankh-below	Zn	ug/L							3			3	3