



School of  
Engineering and  
Applied Sciences

# Lead removal from contaminated soil using electrokinetik remediation method

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# Агуулга

## **Introduction**

- The purpose and objectives of the research
- Soil pollution
- Soil remediation processes
- Soil remediation using Electrokinetic method

## **Experimental part**

## **Result and discussion**

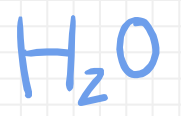
## **Conclusion**

# Introduction



$E = mc^2$

$\sqrt{2}$



## **Basis for research**

The impact of environmental lead pollution on human health has been a major concern in developed and developing countries. It is a matter of fact that Mongolia is not well-versed with them and needs further research.

## **Innovation and significance of the research**

The novelty of the study is to study and reduce lead contaminants with lead in sand and in soil from "Zalamt Gol" LLC.

- ✓ It can contribute to the reduction of heavy metals from soil, in a way that is quick, easy and cost-effective. As a result of the our study, there is a clear understanding of the methodology of soil pollution reduction and can be piloted in reality due to research results.

# The objectives of the research

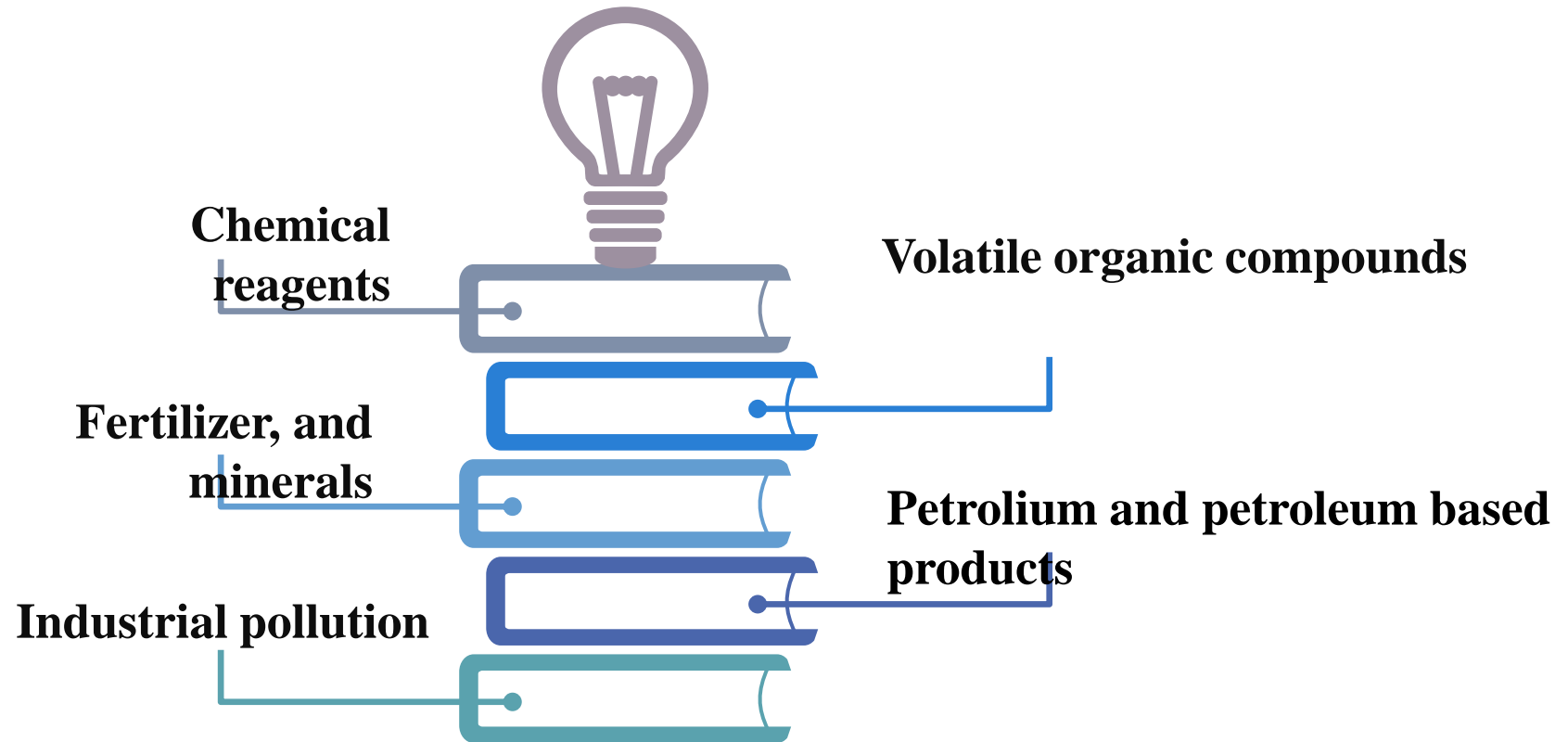
1. Preperation of samples from contaminated soil
2. Determine the amount of lead in the sample
3. Determine the lead minerals in the soil
4. Create Electrokinetik reactor
5. Determination of removal of lead from the soil and sand
6. The comparison study on the original soil and treated soil

# Theoretical part



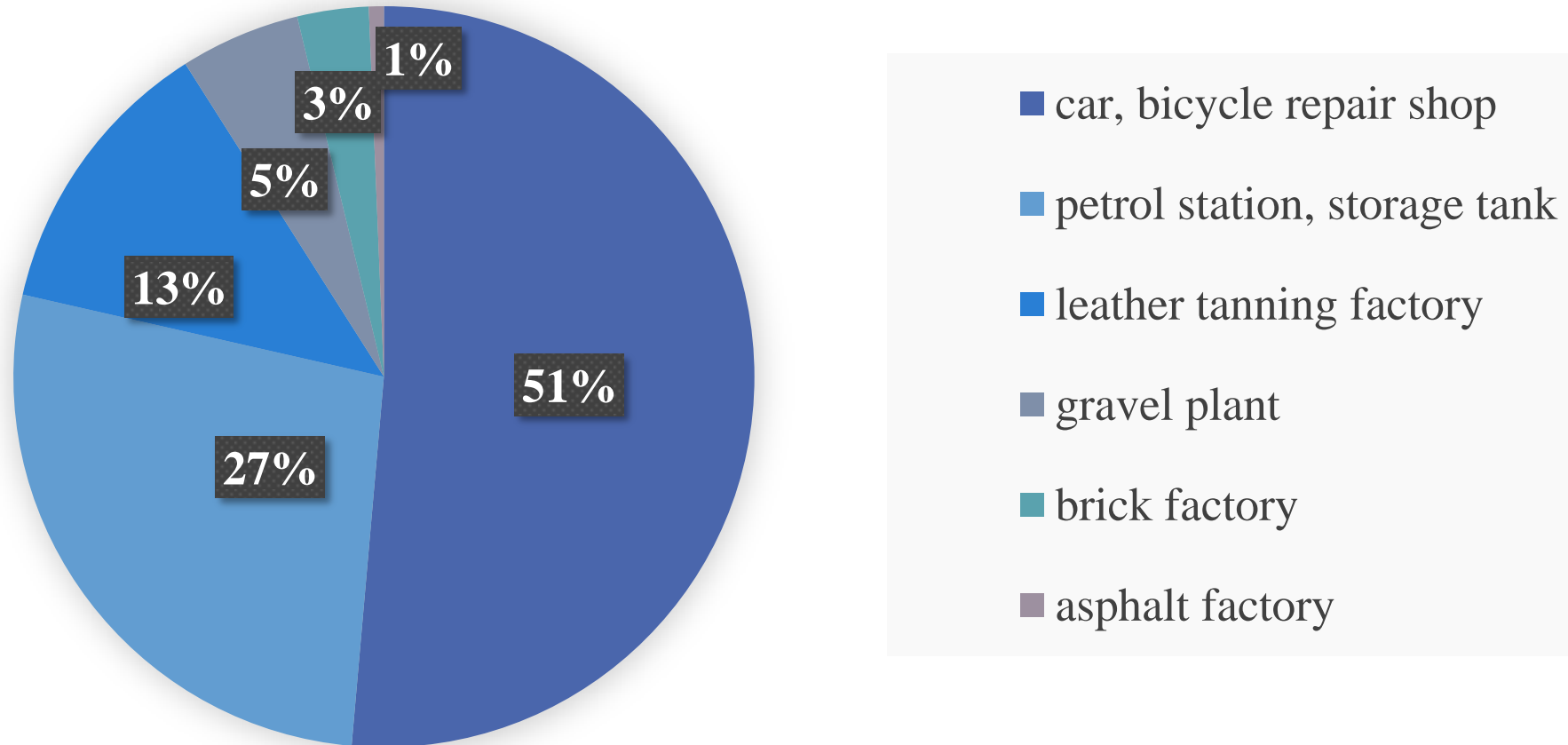
# Soil pollution

Soil pollution is the process of accumulating a variety of organic and inorganic substances in the soil due to human activity, which reaches the level of adverse effects on plants and living organisms.



# Factory in Ulaanbaatar

Amount





# Heavy metals pollution in the soil

Elements of lead (Pb), zinc (Zn), copper (Cu), cadmium (Cd) and mercury (Hg) are caused by human error (coal smoke, car gasoline, fuel, accumulate in soil and accumulate).

## Lead

It is widely used as a technique for easy melting and processing. Lead is used for accumulators of the accumulator, chemical-resistant foil apparatus, paints, and glass. For the purpose of combing arsenic of lead gypsum, sulphate is used to produce rubber products.

### Physical properties

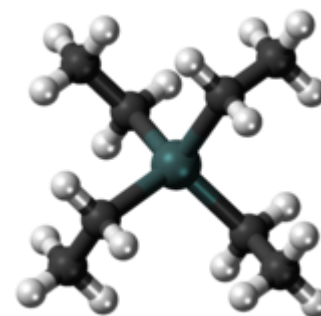
Atomic number: 82

Atom mass: 207.2 g/mol

Density: 11.34 g/cm<sup>3</sup> (20 °C)

Melting temp.: 600.61 K

Boiling temp.: 2022 K Oxidation: +2, +4



# Remediation methods for soil

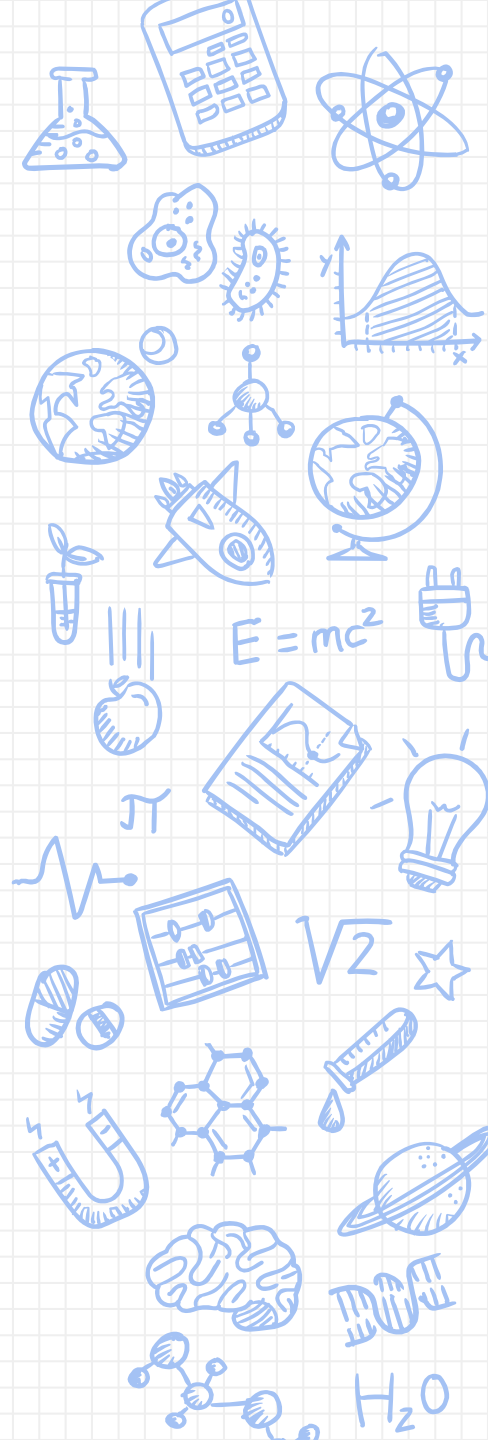
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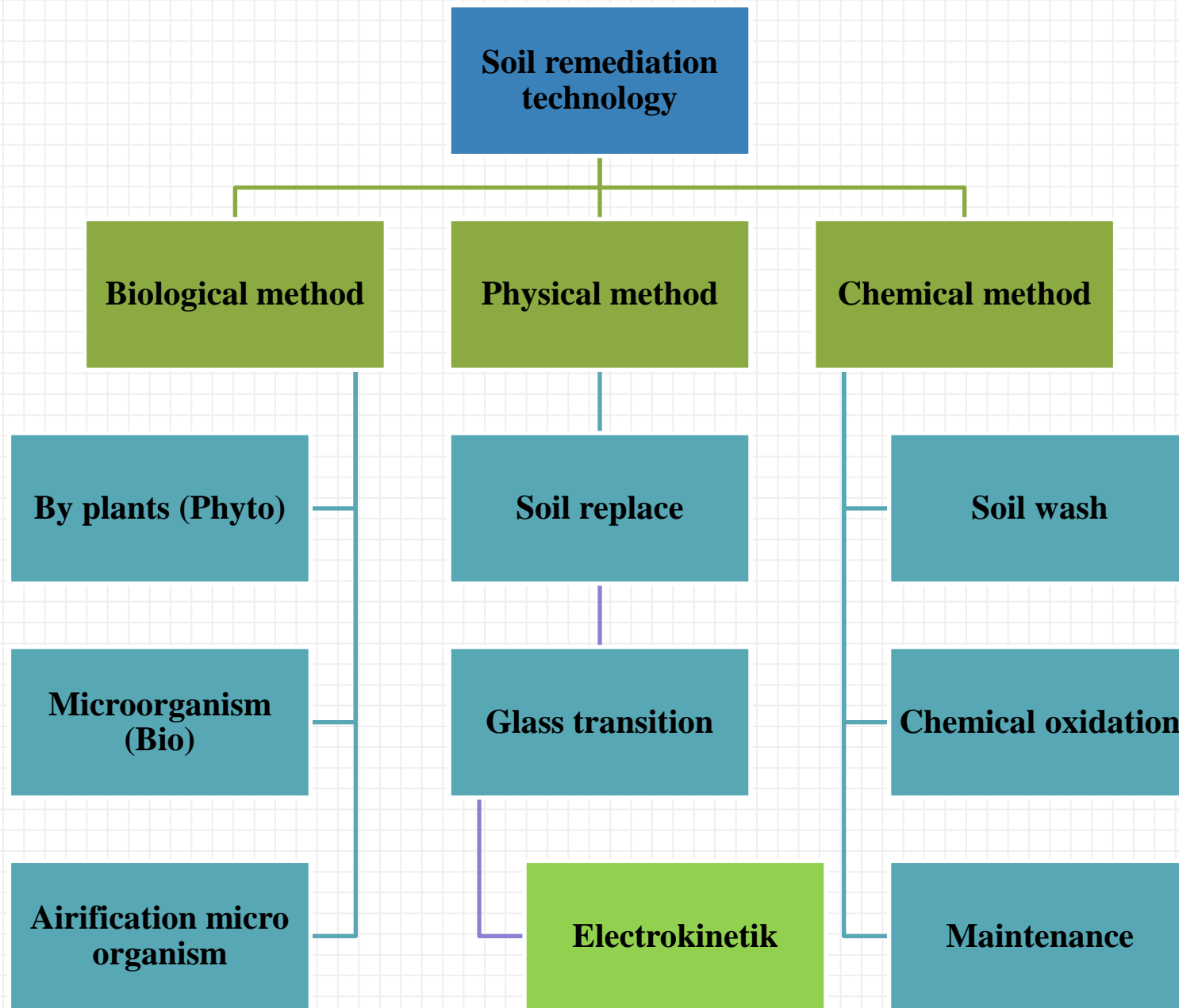
## In situ technology

- ✗ Cleaning the soil is not removed and additional impacts on the site are low
- ✗ Reduces the risk of pollution
- ✗ Relatively slow
- ✗ It is difficult to define the ending of the clearance
- ✗ The cleaning reaction environment is not easily controlled

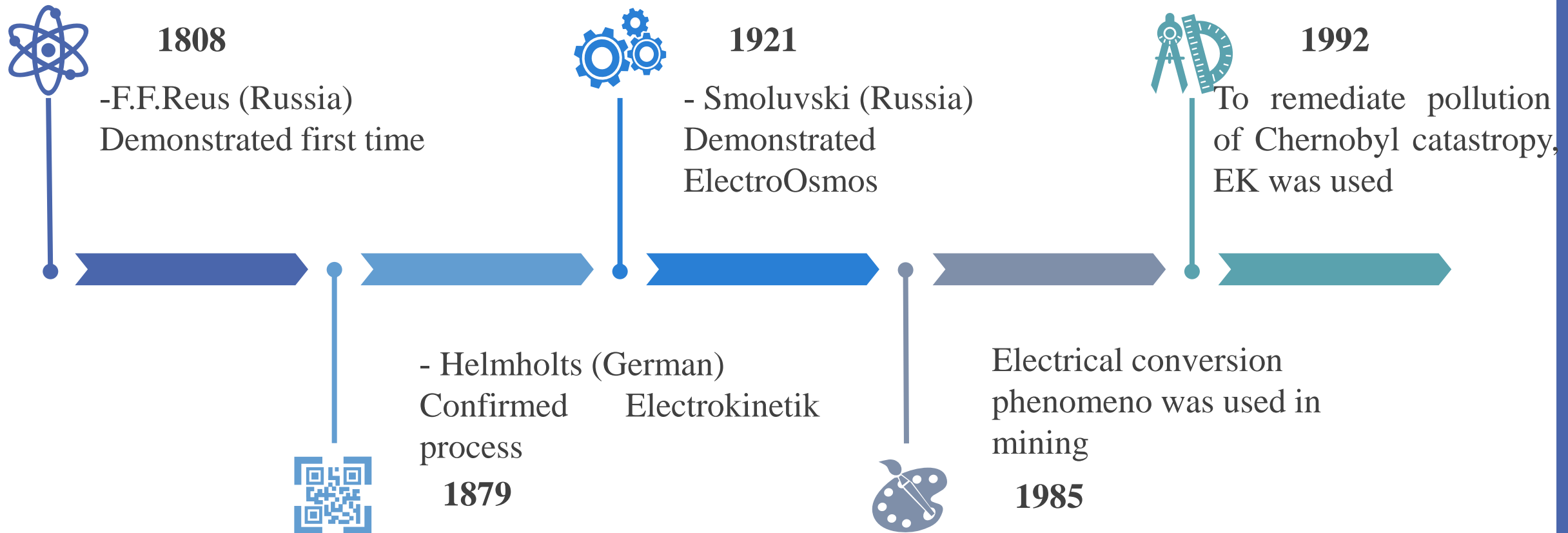
## Ex situ technology

- ✗ Removing dirt from soil to be cleaned and easy to control during cleaning
- ✗ Additional charges are required
- ✗ Rapid results
- ✗ Potential secondary contamination may occur
- ✗ Special area area cleaning is required





# Historical time line for Electrokinetik remediation



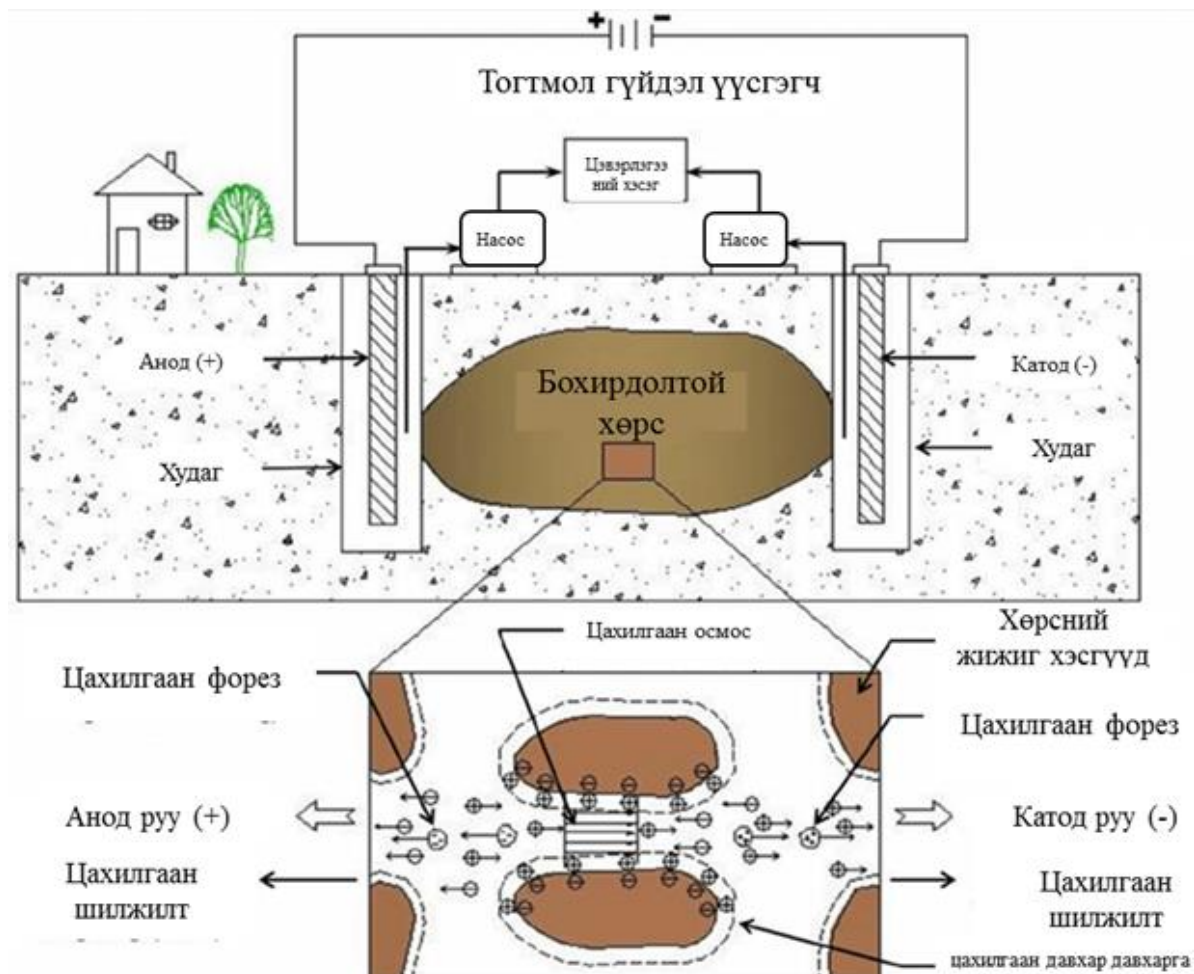
# Electrokinetik remediation

## Electrophoresis

It is called as motion of charged small particles in a electrical field.

## Electrical osmos

It is called as water molecules carry and penetrate with ions through pores of soil.



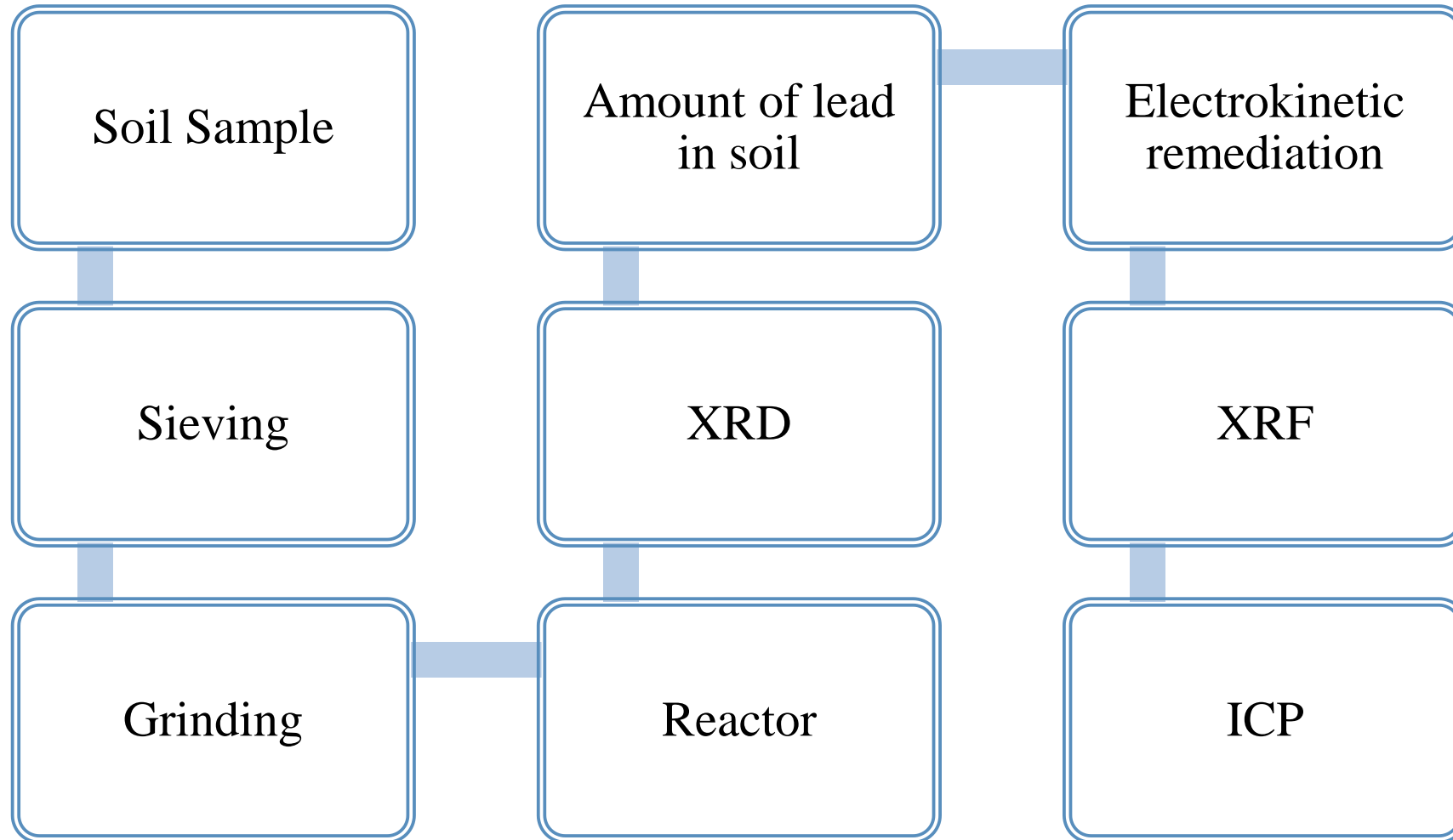
## Electrical shift

Motions of ions from anode to cathode is called as electrical shift phenomena.

# Туршилтын хэсэг



# Experimental scheme



# Research site



“Zalamt gol” LLC

The old accumulator is bought and reprocessed from the market. Dissolved sulfuric acid is supplied to cathode copper industries. Produces useful products by recycling the accumulation of lead accumulators of environmentally-hazardous wastes.

“Elsnii gol” factory

It is located in the center of 50 km from Ulaanbaatar. A total of 55 hectares of land and its "Sand Selling Point" site, which is located at the Company's site in Ulaanbaatar, is located at the site of 5000m<sup>3</sup> sand.



# ДЭЭЖ АВАЛТ



In order to determine the composition, composition, and properties of the substance of the study, the 11th khoroo of Bayanzurkh district, "Zalamt Gol" LLC, and the accumulator of lead melting plant located at "Khongor station".

№	Дээж авсан газар	Байршил
1	The back of the mountain	N:47.75.15.15 E:107.19.21.25
2	Northwest corner of the factory fence	N:47.45.08.72 E:107.11.38.13
3	From the yard on the left side of the factory	N:47.45.10.23 E:107.11.42.02
4	Backyard factory	N:47.45.09.07 E:107.11.43.01
5	The front of the factory	N:47.45.07.41 E:107.11.45.11

# Sample selection



In our study, the lead content was chosen to conduct electrochemical reclamation in sample # 4, the largest soils in the soil.

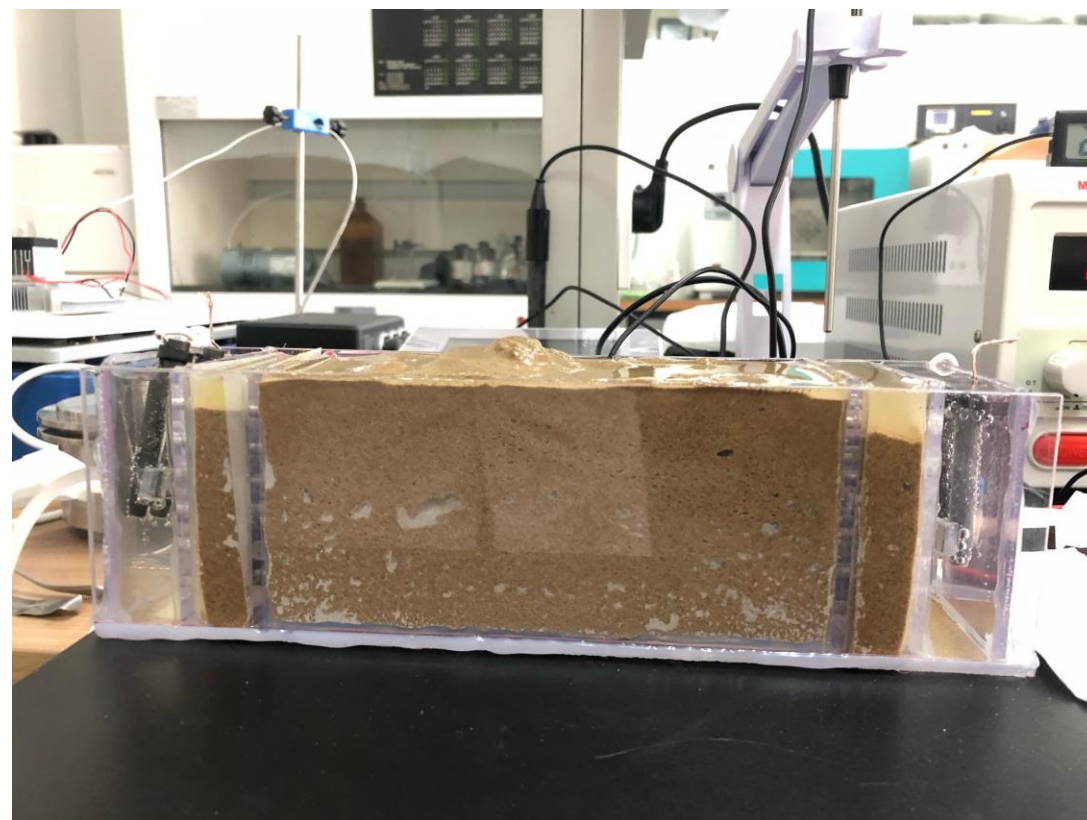
# Electrokinetik remediation

## Reactor :

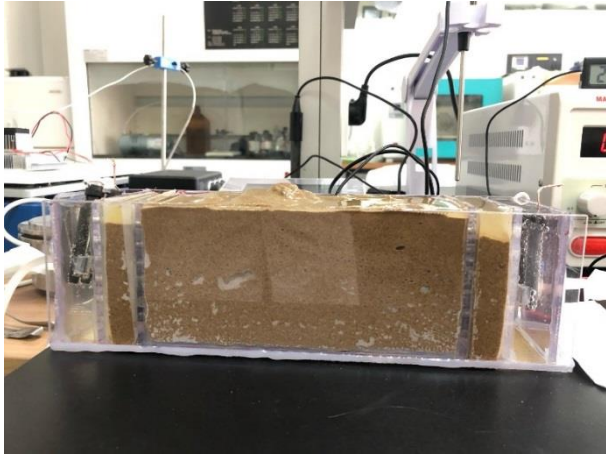
- Electrokinetik cell
- Graphite electrode, 2ps
- Room for electrode, 2III
- Power supply

## Condition:

- Voltage: 100 V
- Duration of the exp: 9-21 цаг
- Electric solution: 0.1M citric acid
- Time: 15 h, 30 h, 45 h, 60 h, 75 h

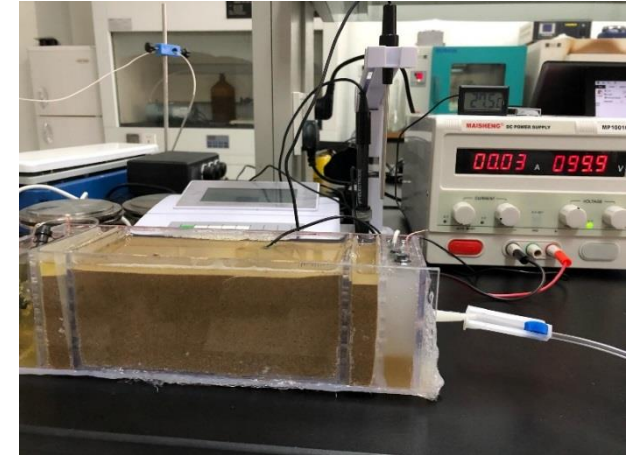


# Reaction process

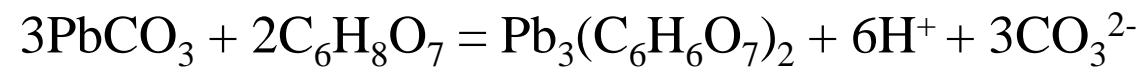


0.1 M  $C_6H_8O_7$  solution

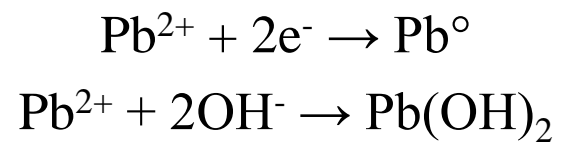
Sand +  $PbCO_3$



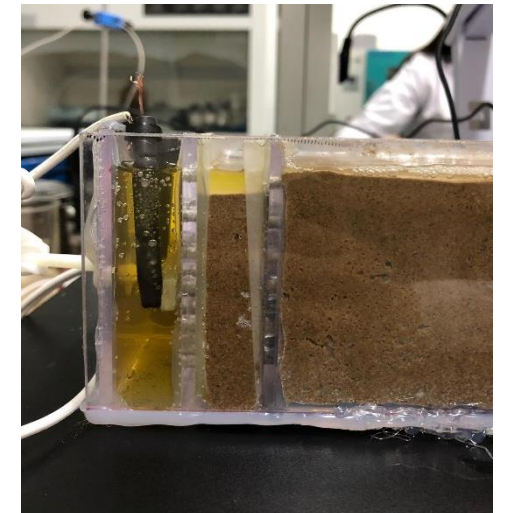
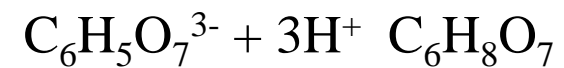
In the solution of electrolyte



Cathode



Anode



# Result, Discussion



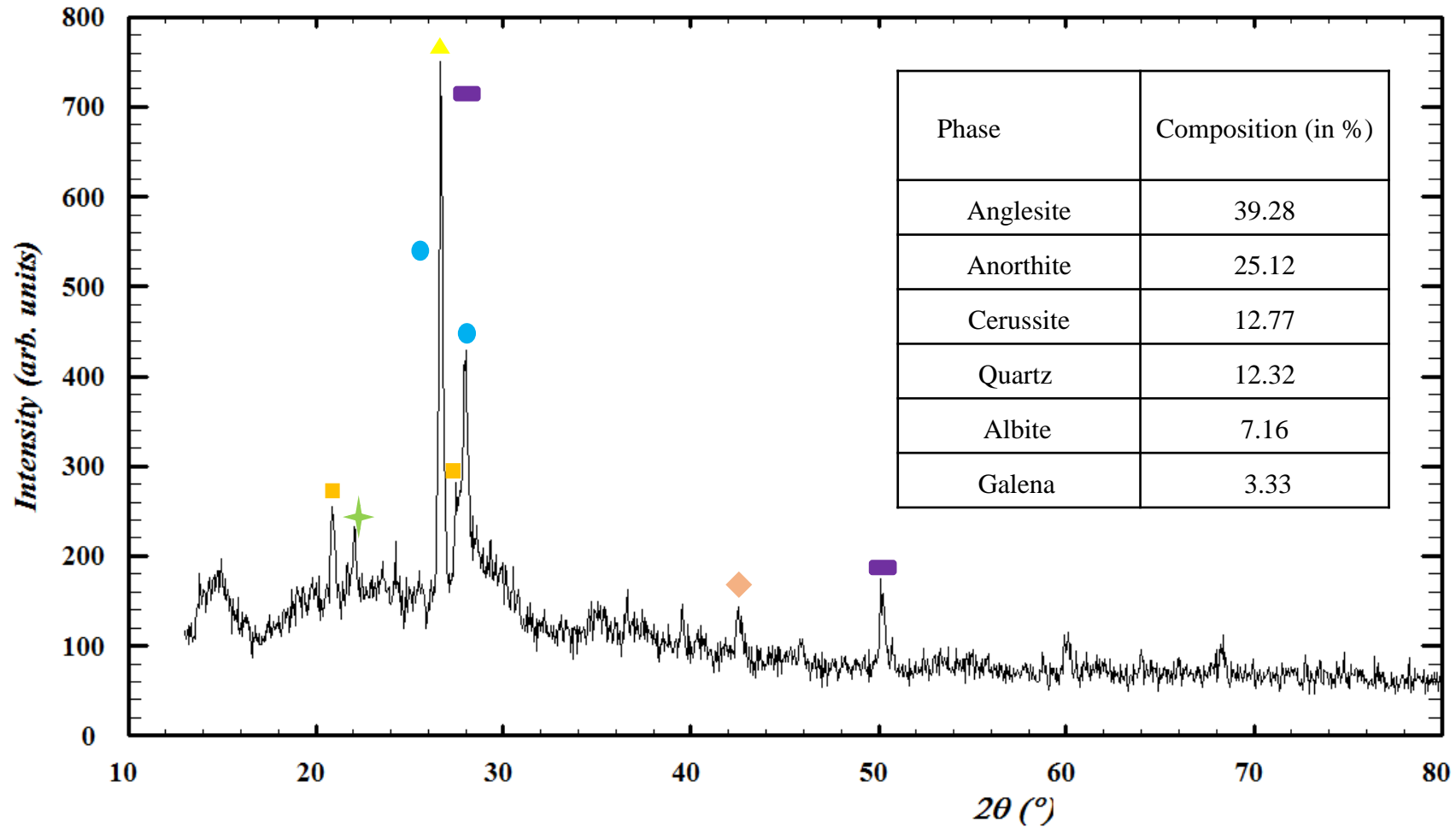
# Content of lead

According to the Mongolian soil quality standard MNS5850: 2008,

- ❑ the permissible level of lead in the soil is 100 mg / kg,
- ❑ the level of toxicity is 500 mg / kg, and
- ❑ the hazardous content is 1200 mg / kg

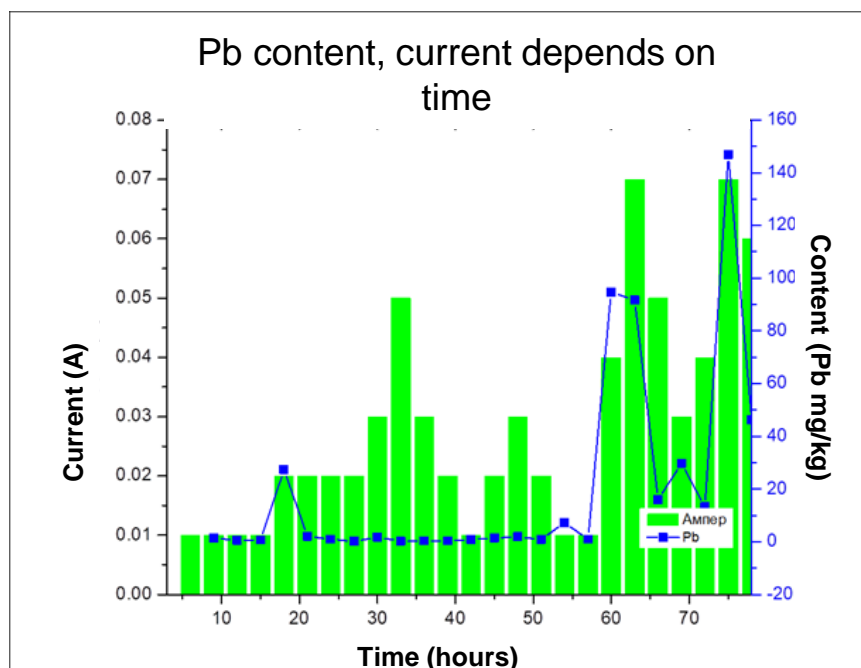
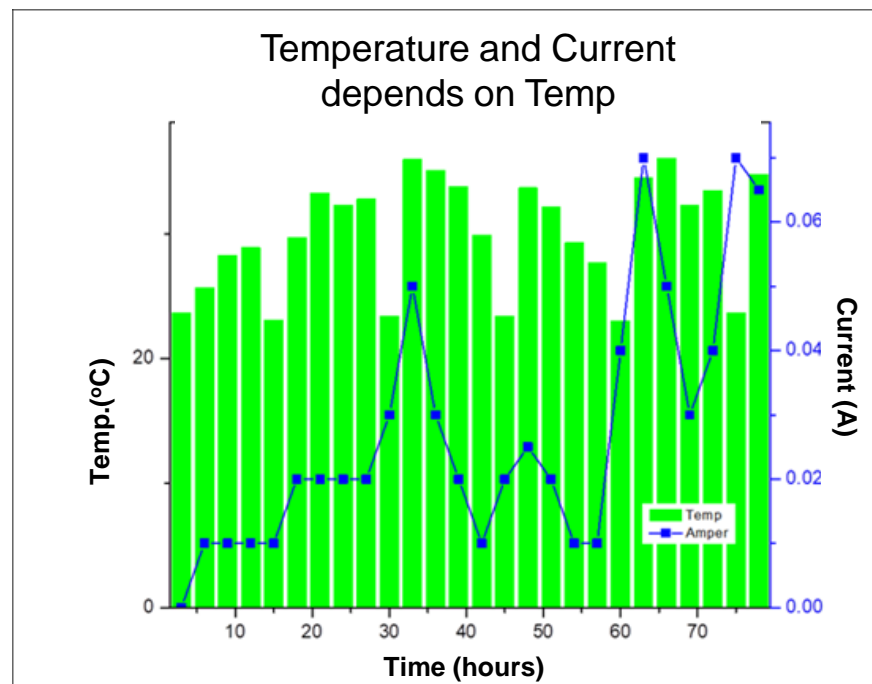
№	Number of soil sample	Soil characteristics			
		Weight, g	Volume of titration, ml	Content of lead in soil, mg/kg	Content of lead in soil, %
1	№1	0.5073	0.15	306.031934	0.030
		0.5082	0.10	203.659976	0.020
		0.5078	0.14	285.348562	0.028
2	№2	0.5008	0.40	826.677316	0.082
		0.5080	0.15	305.610236	0.030
		0.5035	0.12	246.673284	0.025
3	№3	0.5058	0.30	613.879004	0.061
		0.5031	0.20	411.449016	0.041
		0.5028	0.18	370.525060	0.037
4	№4	0.5065	2.20	4495.55775	0.4495
		0.5046	2.50	5127.82402	0.5127
		0.5020	2.15	4432.76892	0.4432
5	№5	0.5051	0.30	614.729756	0.0614
		0.5022	0.25	515.232975	0.0515
		0.5032	0.20	411.367250	0.0411

# Mineral content of the soil



# Experimental result for sand medium

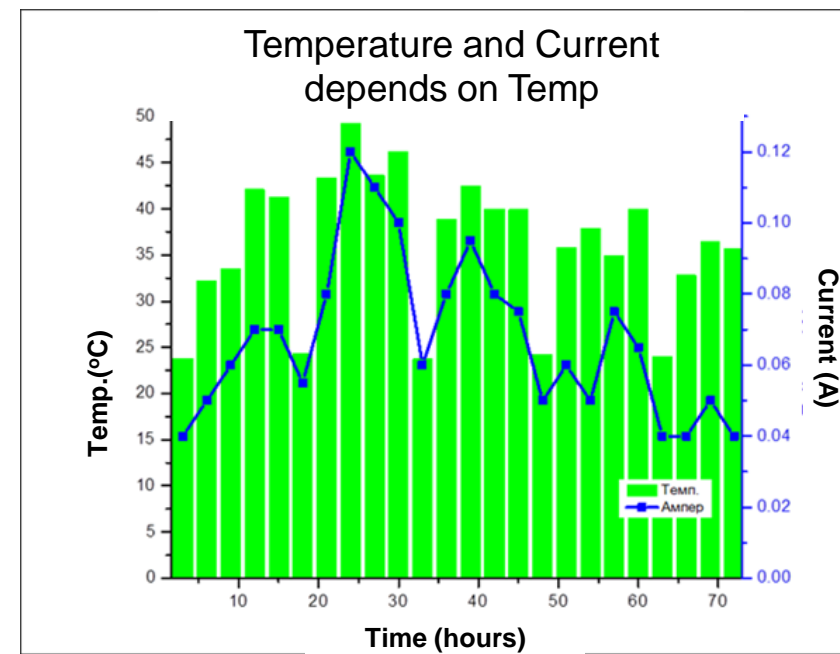
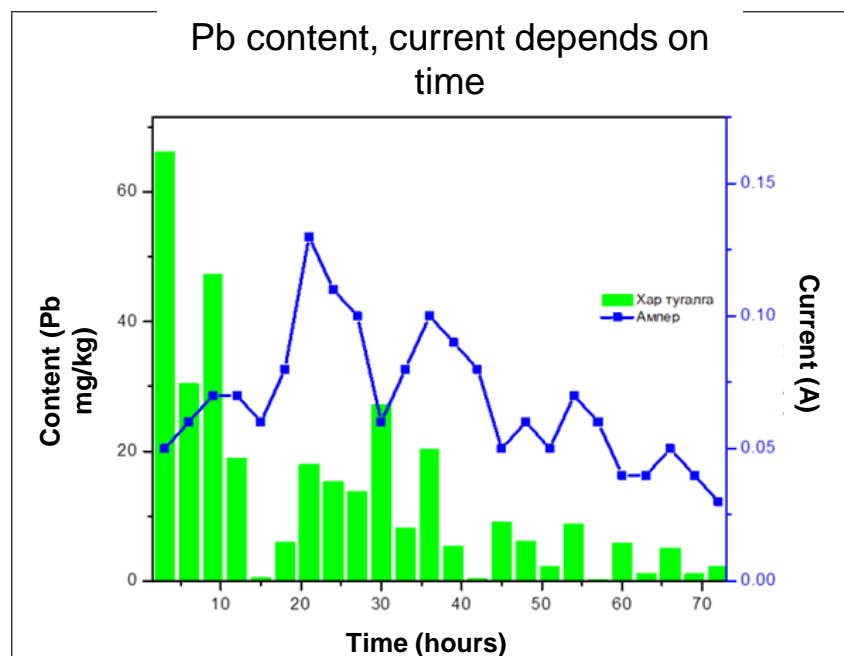
	Element, mg/kg								
	V	Cr	Mn	Co	Ni	Cu	Zn	As	Pb
<b>Raw data of Sand</b>	120.39	61.22	504.27	5.09	0.00	10.26	44.44	95.70	<b>289.66</b>
<b>Artificial sand</b>	126.03	100.21	551.57	5.20	22.83	14.92	35.24	1954.80	<b>5598.6</b>



Sample	Element, mg/kg								
	V	Cr	Mn	Co	Ni	Cu	Zn	As	Pb
<b>After exp. sand</b>	128.11	76.91	430.29	5.64	0.00	91.24	51.78	572.24	1661.7



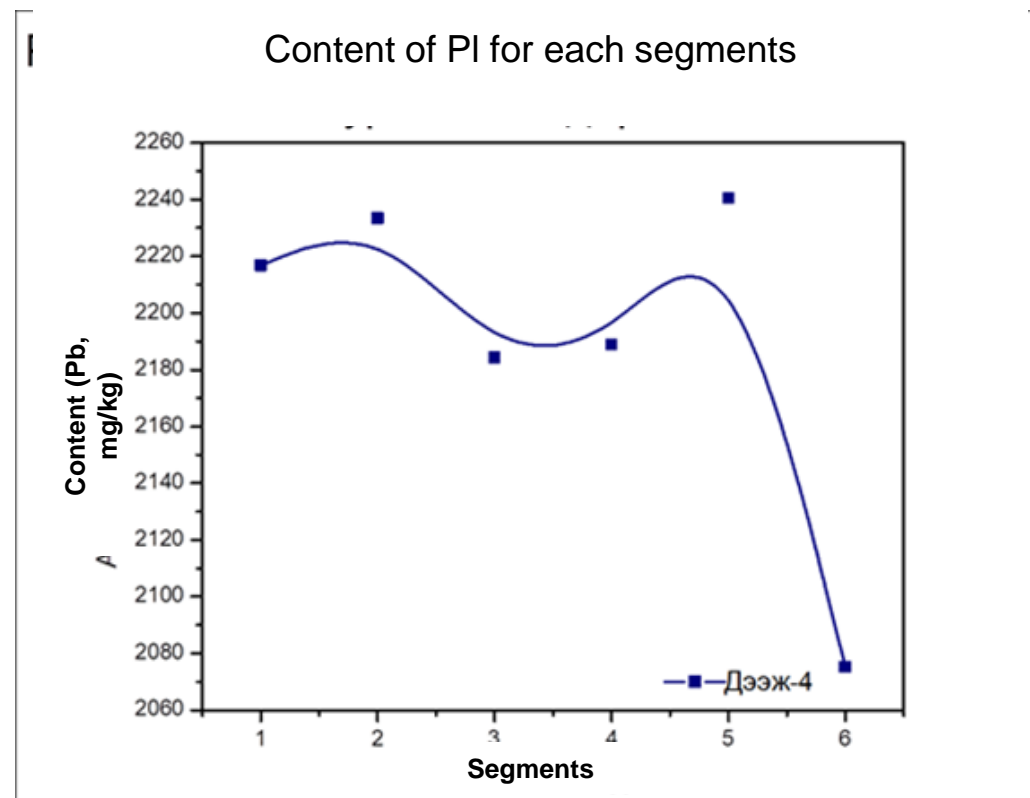
# Result of the exp. for soil



Samples	Elements, mg/kg								
	V	Cr	Mn	Co	Ni	Cu	Zn	As	Pb
Soil sample	128.29	96.07	750.50	14.91	12.28	24.75	120.48	<b>191.95</b>	<b>5222.51</b>
MNS5850:20	150	150	-	50	150	100	300	30	100
08									

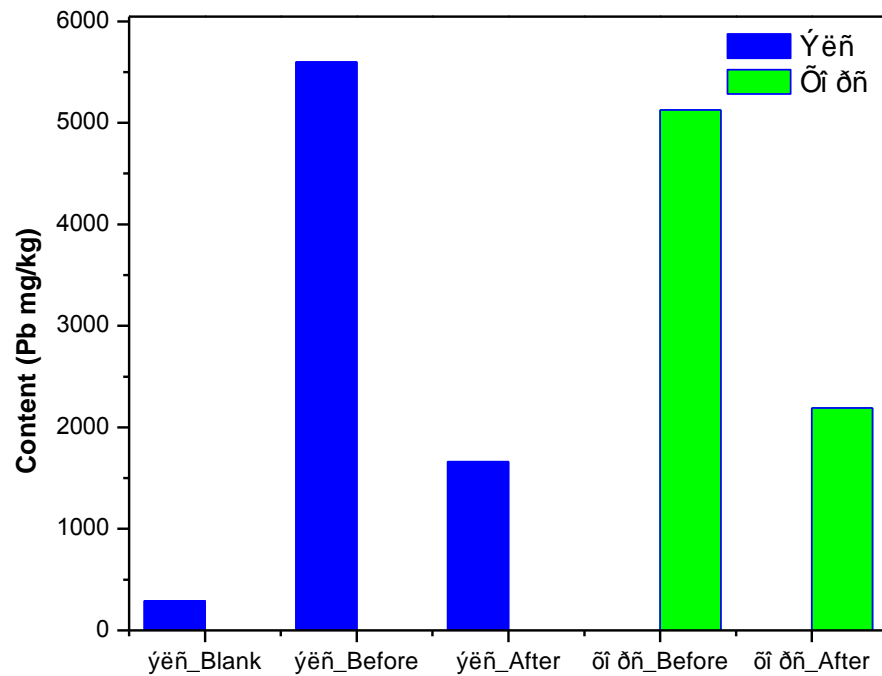
# Ion transfer

# samples	Element, mg/kg								
	V	Cr	Mn	Co	Ni	Cu	Zn	As	Pb
<b>№1</b>	134.8 4	110.7 7	739.9 9	14.26	18.12	66.17	245.00	713.21	<b>2075.32</b>
<b>№2</b>	134.7 4	105.8 5	773.5 3	13.92	19.56	56.55	304.99	770.35	<b>2240.44</b>
<b>№3</b>	118.1 1	107.1 8	776.0 5	15.16	19.68	55.24	274.37	751.37	<b>2188.90</b>
<b>№4</b>	131.5 5	93.07	773.3 7	15.99	31.46	55.30	306.11	752.38	<b>2184.21</b>
<b>№5</b>	125.6 4	95.99	812.1 9	14.50	15.62	63.46	297.08	769.42	<b>2233.41</b>
<b>№6</b>	131.9 6	103.2 1	774.9 2	15.31	30.80	43.44	283.15	759.79	<b>2216.77</b>
<b>MNS5850:2008</b>	150	150	-	50	150	100	300	30	100

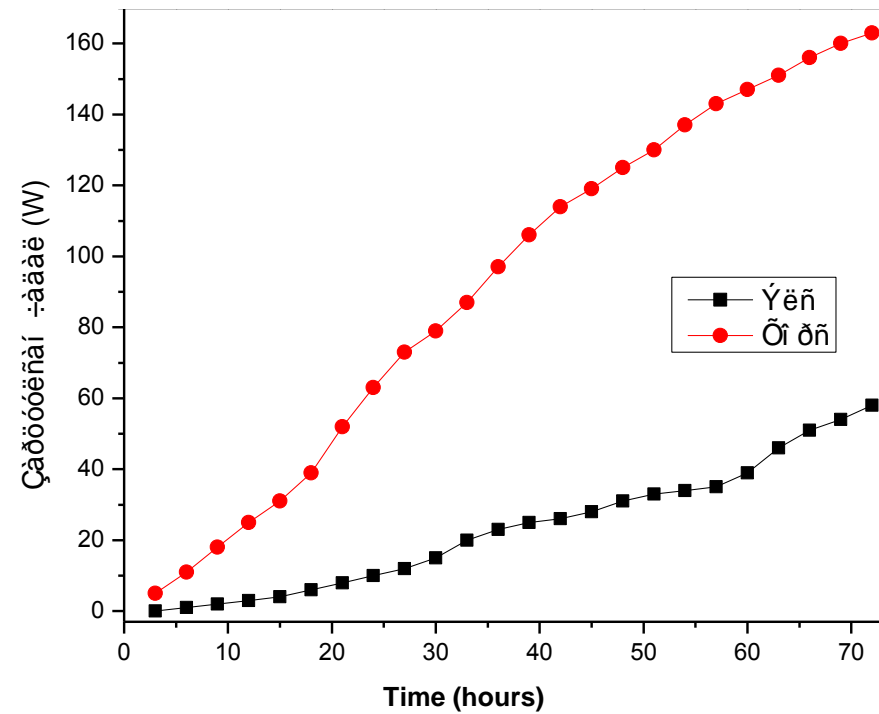


# XRF анализын дүн

Lead contents



Energy consumed in exp.



# Conclusion

- Contaminant content in the soil is contained in samples 4 and 5, 4685.6mg / kg and 514 mg / kg, which is considered hazardous and hazardous content of Mongolian soil quality standard MNS5850: 2008.
- When the soil was separating half of the lead content over a 24-hour period, the sand started to leak during the 53-hour period, leading to lead generation and active release. Therefore, it is assumed that the metal recovered in time has been improved.
- When studying the emulsification properties of lemon acid, the lemon acid has reduced the lead content without harming the environment and the soil structure.
- The lead content in reactor sand decreased by 70% on cathode.
- The lead content in the reactor soil decreased by about 57% in cathodes.
- A total of 58 watts of energy was spent on electrophynnic rehydration in the sand, while a total of 163 watts of power was spent on cleaning the soil, which is approximately three times the amount.

Thank you for your attention