NPO Kinematika, LLC

Method of Targeted Selection of Microorganisms for Bioleaching of Metals

Method of Targeted Selection of Microorganisms (MoTSoM)

Description of MoTSoM Technology

❖MoTSoM Technology steps from all areas of microbiology and is based on the molecular level of exposure to the cell (its genome), without the use of genetic modifications. The studies and tests were conducted on an extensive factual basis.

❖MoTSoM Technology made it possible to bring the ability of microorganisms to adapt and respond to environmental influences to a new level, as well as to significantly increase their reproductive ability.

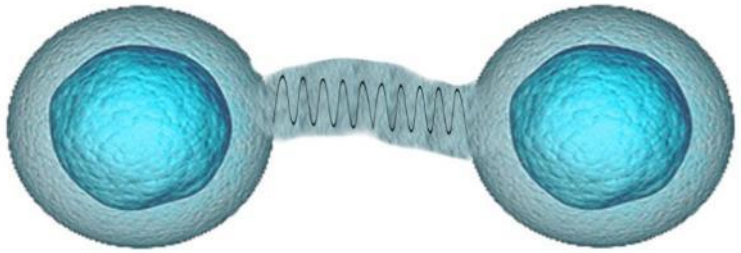
Description of the Information Molecule

- **THE INFORMATION MOLECULE** is a complex organic structure created with the application of the Method of Targeted Selection of Microorganisms (MoTSoM), which acts as a generator, modulator and amplifier of bio-frequencies, when it enters the intercellular space.

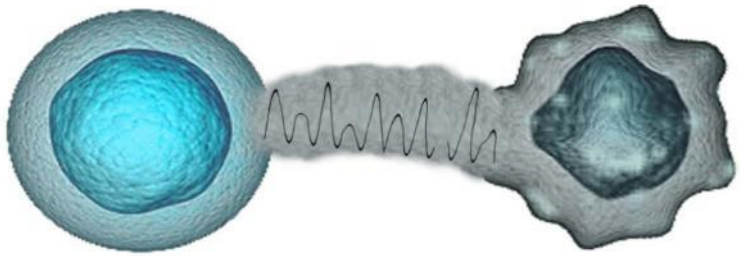
- **THE INFORMATION MOLECULE** reduces entropy in the cell and the surrounding intercellular space is reduced, which leads to changes in energy-consuming reactions and normalises the biologically active structures.

Description of MoTSoM Technology

INTERCELLULAR COMMUNICATION INVOLVING AN "INFORMATION MOLECULE"



Healthy cells

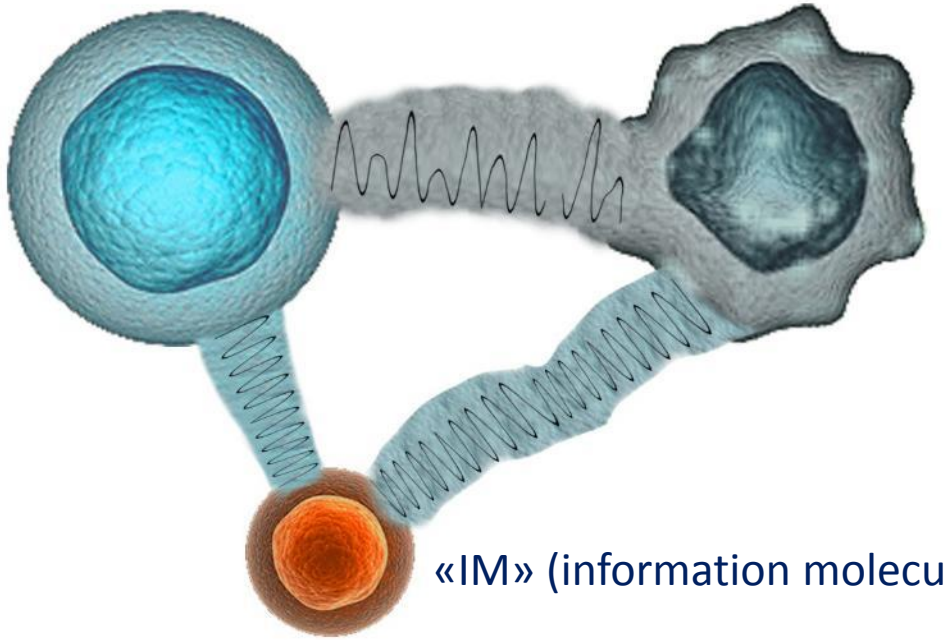


Healthy and damaged cells

One of the types of intercellular communication (there are plenty of them) occurs through electrical signals generated by external field of a cell with wavelengths from 200 to 1 000 nanometres. With a damaged cell, the signal on the channel is broken, while the information molecule helps to stabilise the distorted signal to "normal" or disrupts it.

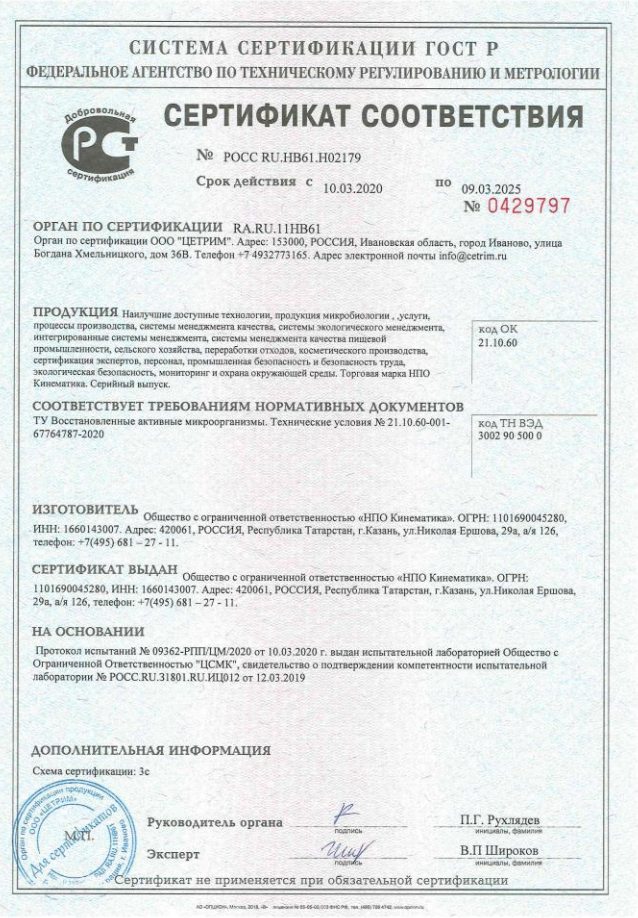
Description of MoTSoM Technology

INTERCELLULAR COMMUNICATION INVOLVING AN "INFORMATION MOLECULE"



Rubrene molecules in the complex allow the information molecule to consistently generate radiation in a given range. Information molecule makes it possible to identify the damaged cells with the amended DNA, produce healthy cells, and activate the natural mechanisms of neutralisation of foreign cells.

Certificate of Compliance



СИСТЕМА СЕРТИФИКАЦИИ ГОСТ Р

ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ТЕХНИЧЕСКОМУ РЕГУЛИРОВАНИЮ И МЕТРОЛОГИИ

СЕРТИФИКАТ СООТВЕТСТВИЯ

№ РОСС RU.HB61.H02179

Срок действия с 10.03.2020 по 09.03.2025

№ 0429797

ОРГАН ПО СЕРТИФИКАЦИИ RA.RU.11HB61

Орган по сертификации ООО "ЦЕТРИМ". Адрес: 153000, РОССИЯ, Ивановская область, город Иваново, улица Богдана Хмельницкого, дом 36В. Телефон +7 4932773165. Адрес электронной почты info@cetrim.ru

ПРОДУКЦИЯ Наилучшие доступные технологии, продукция микробиологии , услуги, процессы производства, системы менеджмента качества, системы экологического менеджмента, интегрированные системы менеджмента, системы менеджмента качества пищевой промышленности, сельского хозяйства, переработки отходов, косметического производства, сертификация экспертов, персонал, промышленная безопасность и безопасность труда, экологическая безопасность, мониторинг и охрана окружающей среды. Торговая марка НПО Кинематика. Серийный выпуск.

код ОК 21.10.60

СООТВЕТСТВУЕТ ТРЕБОВАНИЯМ НОРМАТИВНЫХ ДОКУМЕНТОВ

ТУ Восстановленные активные микроорганизмы. Технические условия № 21.10.60-001-67764787-2020

код ТН ВЭД 3002 90 500 0

ИЗГОТОВИТЕЛЬ Общество с ограниченной ответственностью «НПО Кинематика». ОГРН: 1101690045280, ИНН: 1660143007. Адрес: 420061, РОССИЯ, Республика Татарстан, г.Казань, ул.Николая Ершова, 29а, а/я 126, телефон: +7(495) 681 – 27 - 11.

СЕРТИФИКАТ ВЫДАН Общество с ограниченной ответственностью «НПО Кинематика». ОГРН: 1101690045280, ИНН: 1660143007. Адрес: 420061, РОССИЯ, Республика Татарстан, г.Казань, ул.Николая Ершова, 29а, а/я 126, телефон: +7(495) 681 – 27 - 11.

НА ОСНОВАНИИ

Протокол испытаний № 09362-РПП/ЦМ/2020 от 10.03.2020 г. выдан испытательной лабораторией Общество с Ограниченной Ответственностью "ЦСМК", свидетельство о подтверждении компетентности испытательной лаборатории № РОСС.RU.31801.RU.ИЦ012 от 12.03.2019

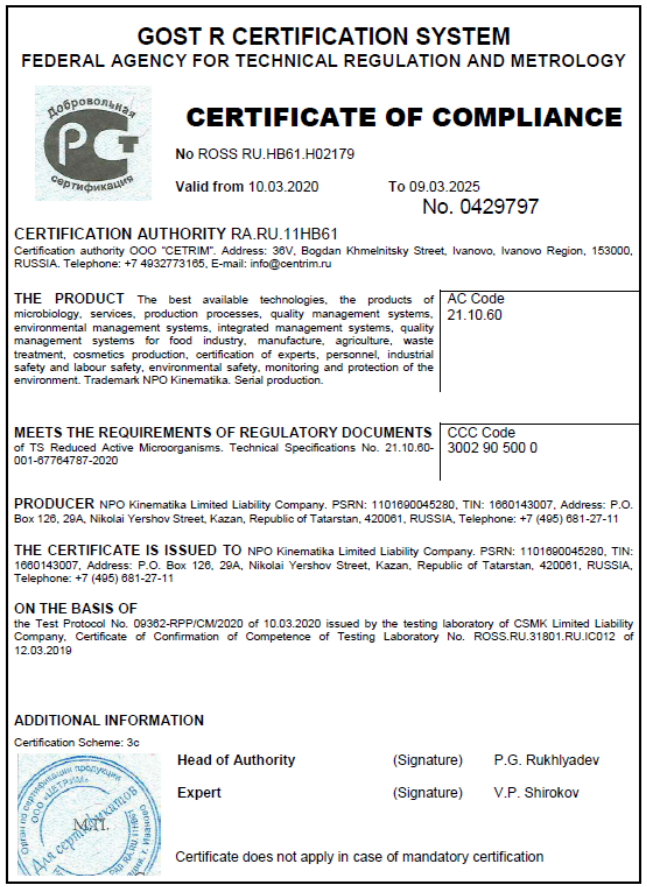
ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Схема сертификации: 3с

Руководитель органа П.Г. Рухлядев

Эксперт В.П Широков

Сертификат не применяется при обязательной сертификации



GOST R CERTIFICATION SYSTEM

FEDERAL AGENCY FOR TECHNICAL REGULATION AND METROLOGY

CERTIFICATE OF COMPLIANCE

No ROSS RU.HB61.H02179

Valid from 10.03.2020 To 09.03.2025

No. 0429797

CERTIFICATION AUTHORITY RA.RU.11HB61

Certification authority OOO "CETRIM". Address: 36V, Bogdan Khmelnitsky Street, Ivanovo, Ivanovo Region, 153000, RUSSIA. Telephone: +7 4932773165, E-mail: info@centrim.ru

THE PRODUCT The best available technologies, the products of microbiology, services, production processes, quality management systems, environmental management systems, integrated management systems, quality management systems for food industry, manufacture, agriculture, waste treatment, cosmetics production, certification of experts, personnel, industrial safety and labour safety, environmental safety, monitoring and protection of the environment. Trademark NPO Kinematika. Serial production.

AC Code 21.10.60

MEETS THE REQUIREMENTS OF REGULATORY DOCUMENTS of TS Reduced Active Microorganisms. Technical Specifications No. 21.10.60-001-67764787-2020

CCC Code 3002 90 500 0

PRODUCER NPO Kinematika Limited Liability Company. PSRN: 1101690045280, TIN: 1660143007, Address: P.O. Box 126, 29A, Nikolai Yershov Street, Kazan, Republic of Tatarstan, 420061, RUSSIA, Telephone: +7 (495) 681-27-11

THE CERTIFICATE IS ISSUED TO NPO Kinematika Limited Liability Company. PSRN: 1101690045280, TIN: 1660143007, Address: P.O. Box 126, 29A, Nikolai Yershov Street, Kazan, Republic of Tatarstan, 420061, RUSSIA, Telephone: +7 (495) 681-27-11

ON THE BASIS OF the Test Protocol No. 09362-RPP/CM/2020 of 10.03.2020 issued by the testing laboratory of CSMK Limited Liability Company, Certificate of Confirmation of Competence of Testing Laboratory No. ROSS.RU.31801.RU.IC012 of 12.03.2019

ADDITIONAL INFORMATION

Certification Scheme: 3c

Head of Authority (Signature) P.G. Rukhlyadev

Expert (Signature) V.P. Shirokov

Certificate does not apply in case of mandatory certification

MoTSoM Technology has a Certificate of Compliance and is ready for industrial use.

Research for Metal Bioleaching

"Study of Influence of Information Molecule on Activity of Aboriginal Heterotrophic (Aerobic and Anaerobic) Microorganisms Isolated from Mature Fine Tailings of the Uchaly Mining and Metallurgical Combine (UMMC) of the Republic of Bashkortostan, as well as of the off-balance ore of the Murtykty Deposit Association"

Учалинский горно-обогатительный комбинат

ОБОГАТИТЕЛЬНАЯ ФАБРИКА

Россия, Башкортостан, г. Учалы.
Тел. 62774.(9)5633.(9)5601

ПАСПОРТ

Хвостов обогащения Учалинской обогатительной фабрики

Наименование материала: лежалые отвальные хвосты УОФ.

Вес пробы: 80 кг

Дата отбора: 13.10.2017 г.

Место отбора: главный корпус ОФ

Метод отбора: ручной, пробоотборником по ГОСТ 14180-80

Содержание полезных компонентов

Наименование продукта	Массовая доля компонентов				
	Cu, %	Zn, %	S, %	Au, г/т	Ag, г/т
Лежалые хвосты УОФ От 13.10.2017г.	0,12	0,26	31,8	1,1	15,2

Назначение пробы: для исследований

Место назначения: ООО «НПО Кинематика», р. Татарстан, г. Казань, ул. Восстания, д. 100.

Главный обогатитель
АО «Учалинский ГОК»: Р.Х.Шарипов

Research for Metal Bioleaching

Sampling: Uchaly Mining and Metallurgical Combine (UMMC) and Murtykty field

a) bacteria b) fungus

Pic. 1

Aboriginal heterotrophic microorganisms isolated from the mature fine tailings of UMMC (Bashkortostan, Russia)

a) bacteria b) fungus

Pic. 2

Preparation of accumulative sulfur-oxidizing (a) and nitrifying (b) microorganisms (optional-aerobic, anaerobic) from the mature fine tailings of UMMC (Bashkortostan, Russia)

Research for Metal Bioleaching

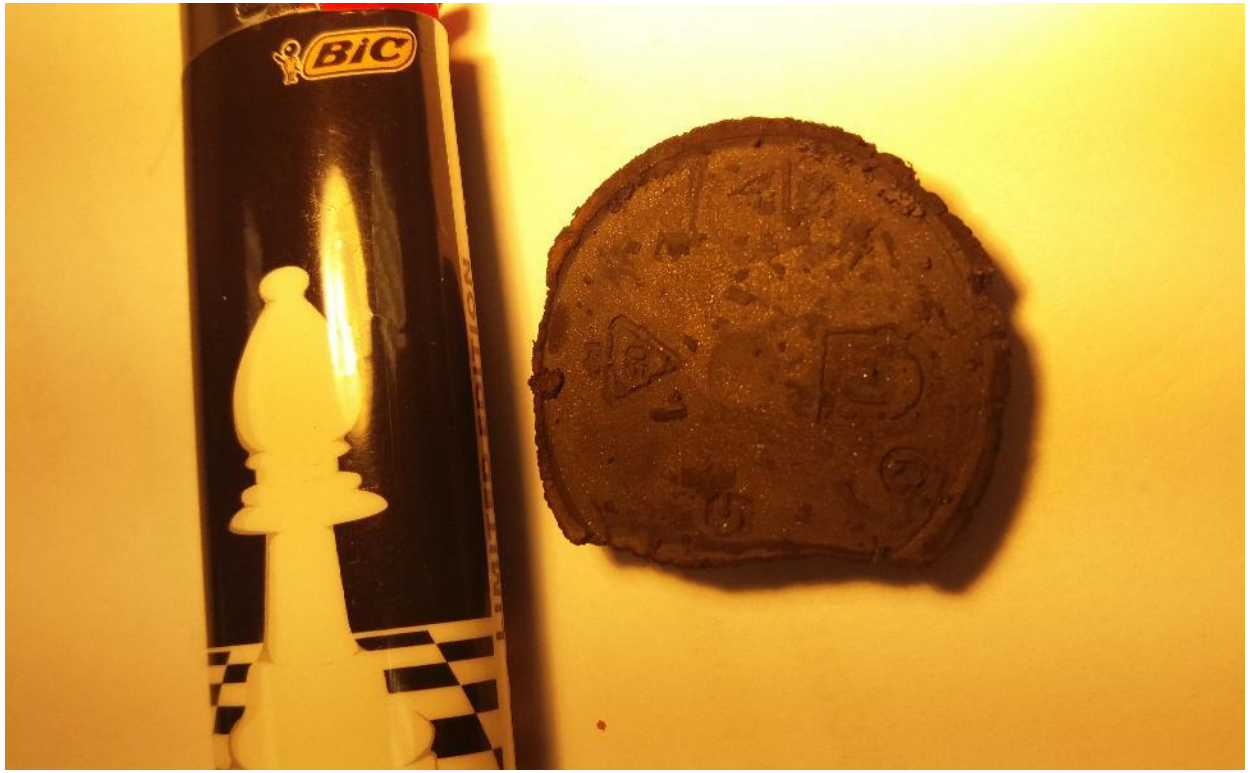
Photos of consortia of bacteria from the mature fine tailings of the Uchaly Mining and Metallurgical Combine (including salt-loving ones) at various stages of development on the 9th day.

a b c d

In the photo:
a - control group (without IM);
b - group with IM at a concentration of 1: 1,000,000;
c - group with IM at a concentration of 1: 100,000;
d is a group with IM at a concentration of 1: 10,000.

The photo (3 days on the nutrient medium) shows a significant increase in the activity of microorganisms after MoTSoM treatment according to the technology compared to the control group.

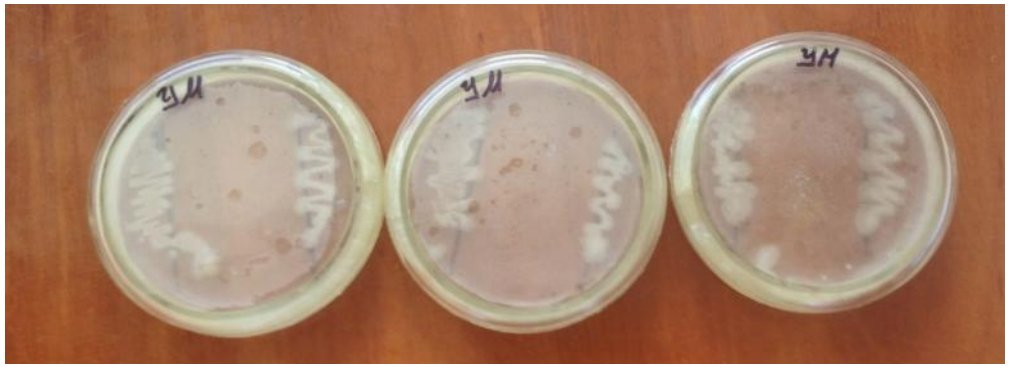
Research for Metal Bioleaching



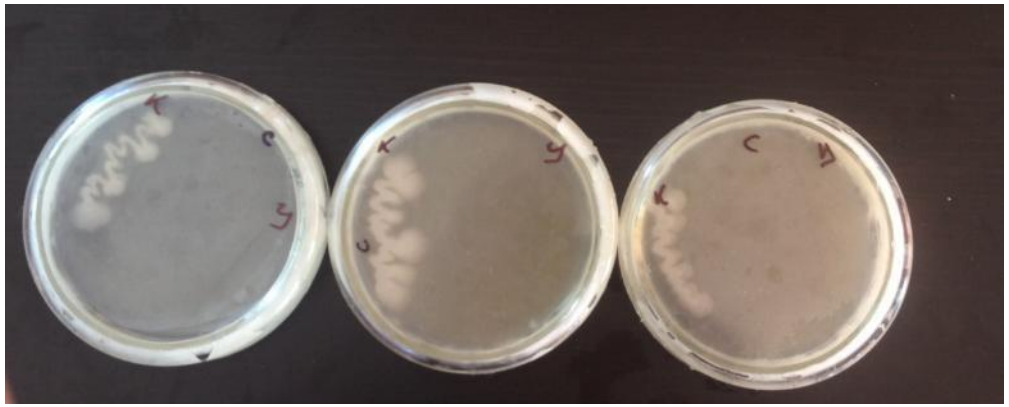
Research for Metal Bioleaching

Growth of the starter culture and association of optional-aerobic and anaerobic microorganisms in the test with the action of IM (test) and without it (control).

a) Test



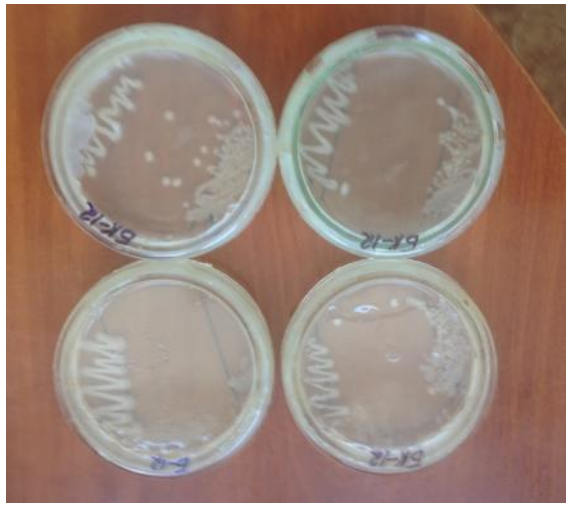
b) Control



Pic. 5

Research for Metal Bioleaching

Growth of starter culture and optional-aerobic and anaerobic microorganisms (B-12). Sample from off-balance ore of the Murtykty deposit (Bashkortostan, Russia).



a) Test

b) Control

There was a significant increase in the activity of microorganisms after MoTSoM treatment (left) in comparison with the control group (without IM).

Research for Metal Bioleaching

Indicators of bacterial leaching of specific compounds (mg/dm^3) from the mature fine tailings of the Uchaly MMC and % extraction.

Test No. 1 (05- 25.05.2018. Duration: 20 days)

Metal mg/dm^3	Initial soil	Soil				Natural – watered solution	
		IM 1:100 000	Recovery rate in %	IM 1:1 000 000	Recovery rate %	1	2
Copper, Cu	26.9	11.8	56.2	22.4	16.7	141.3	165.1
Zinc, Zn	132.6	82.0	38.2	82.9	37.5	801.9	970.8
Iron, Fe	976.0	733.9	24.8	678.4	30.5	6 905.0	7 784.0
Sulfates	5 202.62	3 469.9	33.3	3 700.20	28.9	6 562.97	3 379.0

Research for Metal Bioleaching

Indicators of bacterial leaching of individual compounds (mg/dm^3) from the mature fine tailings of the Uchaly plant and% extraction.

Test No. 2 (25.06.2018- 05.07.2018. Duration: 40 days)

Metal mg/dm^3	Initial soil	Soil			
		IM 1:100 000	Recovery rate in %	IM 1:1 000 000	Recovery rate in %
Copper, Cu	20	10,7	46,5	6,6	67
Zinc, Zn	7,2	2,5	65,2	1,2	83,3
Iron, Fe	590	279	52,7	210	64,4
Sulphates	3122	2463	21,1	1800	42,3

Conclusions: the rate of recovery of target metals was increased from 7 to 40 times* (for copper)

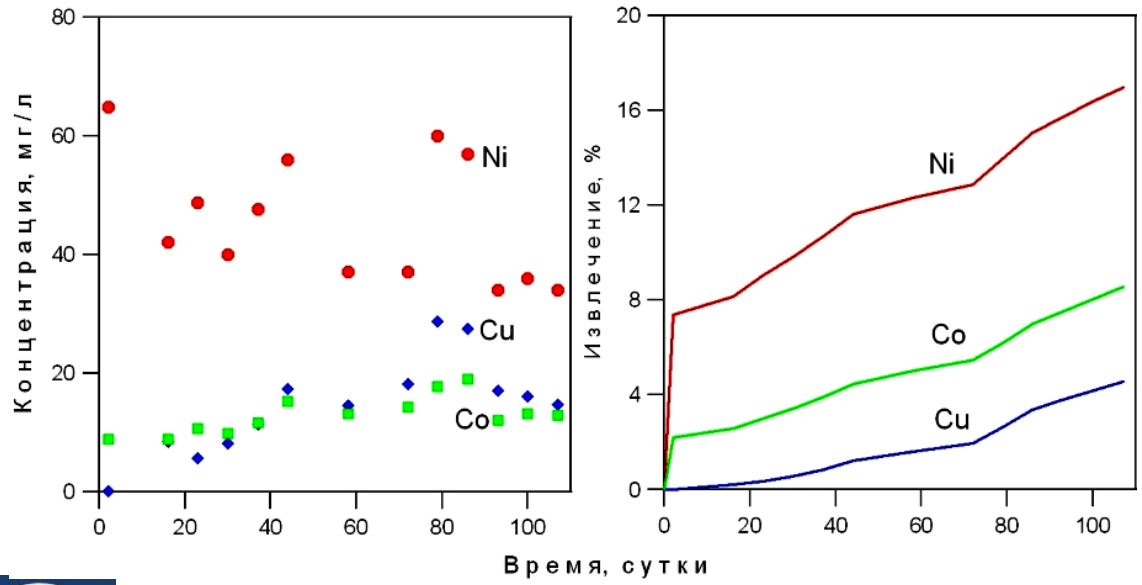
Results: copper recovery 56% in 20 days

* In comparison with the results of laboratory modeling, described in the article by A.V. Svetlov, D.V. Makarov, V.A. Masloboyev "Possibilities of heap bioleaching of substandard copper-nickel ores and man-made raw materials“, Institute of Problems of Industrial Ecology of the North KSC RAS, Apatity, 2016.

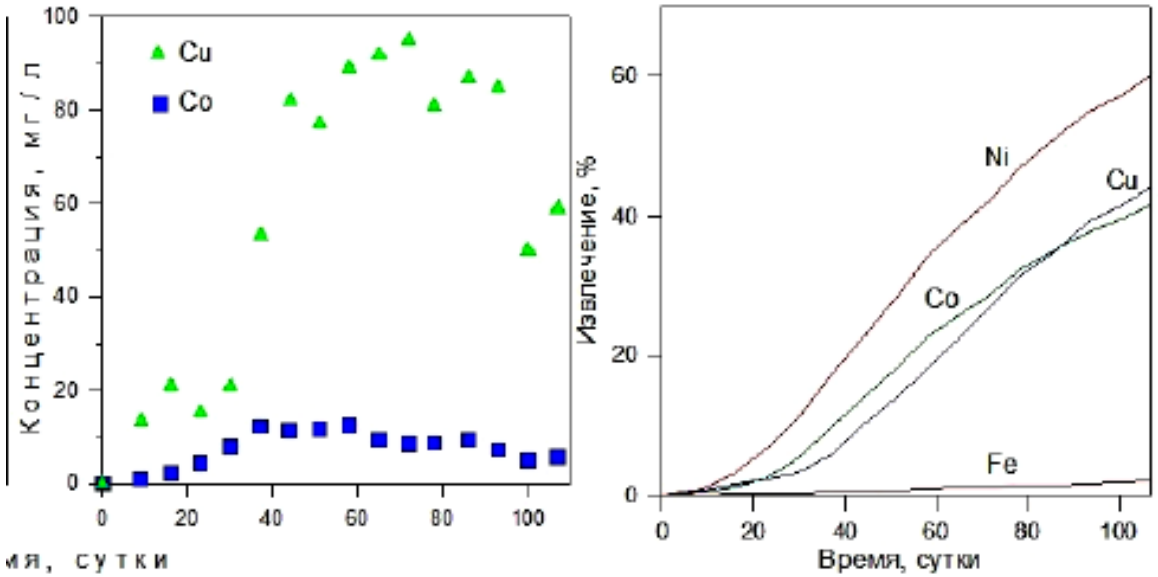
Research for Metal Bioleaching

Results obtained using non-activated bacteria during laboratory modelling (A.V. Vetlov, D.V. Makarov, 2016). Given for comparison.

Copper extraction: 4% in 110 days from copper-nickel production granulated slag. Pellets 40 µm; sulphuric acid. On the diagram: metal concentrations in slag leaching solutions and process kinetics.



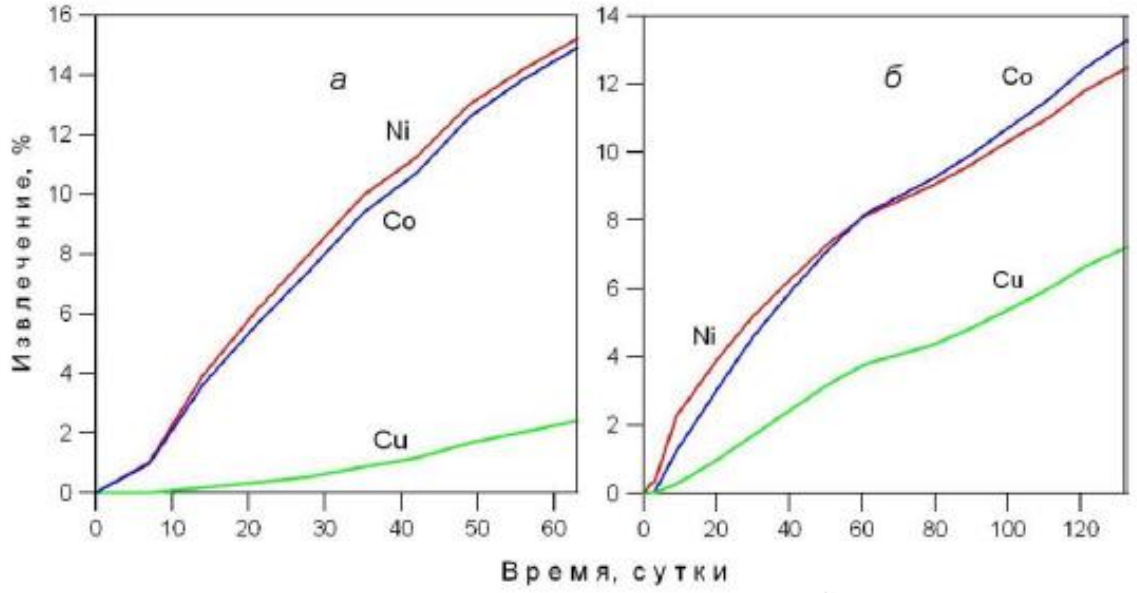
Copper extraction: 44% in 110 days from tails of copper-nickel ores enrichment. On the diagram: metal concentrations in slag leaching solutions and process kinetics.



Research for Metal Bioleaching

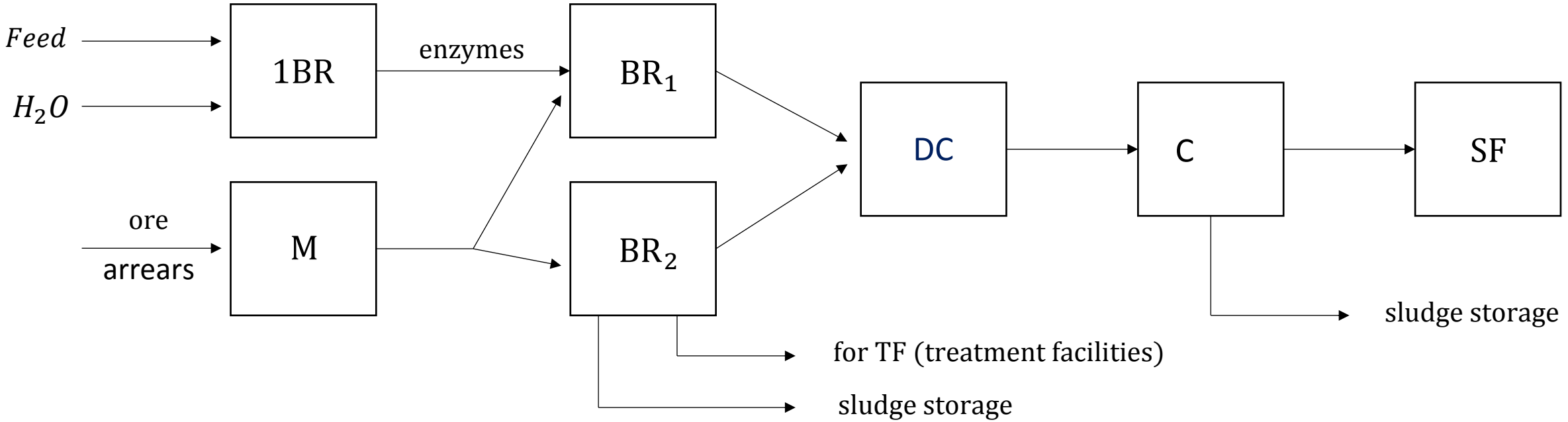
Results obtained using non-activated bacteria during laboratory modeling (A.V. Vetlov, D.V. Makarov, 2016). Given for comparison.

Copper extraction: 7% in 130 days from ore samples. Fractions 3 + 2 mm; sulphuric acid. On the diagram: concentration of metals in leach solutions.



Research for Metal Bioleaching

Process diagram of ore bioprocessing



1. 1OB – fermenter for enzyme production;
2. M – ultra-thin mill;
3. BR_1, BR_2 – bioreactors 24 hours, flushing;
4. DC – drying chamber;
5. C – concentrator;
6. SF – smelting furnace.

Diesel Generator, 220 kW

2

Ore Collection

3

Coarse-ore bin

4

Breaker No. 1

5

Breaker No. 2

6

Concentrator No. 1

7

Mill

8

Concentrator No. 2

9

Magnetic Separator

10

Flotation Unit

11

Bioreactor

12

Concentrate

13.1

Concentrator

13.2

Cyanidation

14

Refining

Processing of Refractory Sulphide Ores

Gold is mainly present as finely divided and submicroscopic forms in close connection with sulphide minerals, usually such as arsenic pyrite and antimony sulphide, pyrrhotite, pyrite, and so on.

Conceptual technological differences:

Conventional technologies	MoTSoM Technology
1. To process 100 tonnes/day, the volume of reactor should be 2 200 m^3	1. To process 100 tonnes/day, the volume of reactor should be 30-50 m^3
2. Time of process: 130-150 hours	2. Time of process: 2-3 hours
3. Sulphuric acid is supplied in quantity of 3 -5%	3. Sulphuric acid is not used: 0%
4. Extraction of gold: 90-97%	4. Equivalent
5. Renewal of consortium of microorganisms is required	5. Renewal is not required. Indigenous microorganisms are used
6. Temperature monitoring is required	6. Temperature monitoring is not required
7. Capital construction only	7. Portable version is possible
8. Increasing supply chain costs	8. Supply chain costs are absent

Research for Metal Bioleaching

Conclusions

- The technology is fully ready for use;
- Extracts any chemical elements (through selection of relevant bacteria); different types of deposits;
- Extremely low cost (allows to reduce the cost of production compared to traditional methods);
- High recovery rate (full cycle in 2 months);
- Does not require an external heat source to heat the bacteria (the process speed is very high and exothermic);
- Environmentally friendly mining: without layer opening, without destroying the landscape (allows heap leaching in northern areas, for example, at deposits with a small concentration of elements);
- Currently, research continues for bioleaching of rare earth metals and other chemical elements.

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Thank you for attention!