POWERSTEEL TECHNOLOGY LLC

START-UP IN THE FIELD OF MINERAL RAW MATERIALS PROCESSING:
CHEMISTRY AND METALLURGY

THE COMPANY WAS ESTABLISHED IN 2020.

THE COMPANY'S GOAL: DEVELOPMENT, SEARCH AND IMPLEMENTATION OF INNOVATIVE TECHNOLOGIES AND PRODUCTS FOR A WIDE RANGE OF MINING ENTERPRISES

We are a team of specialists with 20 years of experience in the fields of chemistry, chemical technology and mineral processing.

Our competencies:

- Creation of highly efficient binder systems for various purposes: production of pellets, agglomerate, briquettes of ore concentrates, coal and coke.
- Mineral processing.
- Hydrometallurgy.
- Technologies for the extraction of non-ferrous and rare metals.
- 20 years of experience in cooperation with leading domestic and foreign manufacturers of chemical raw materials.
- Development of technological regulations and design solutions.
- Development of working documentation.
- Calculation of technological schemes, calculation and selection of equipment.
- Installation supervision.

THE MAIN ACTIVITIES OF THE COMPANY

1. Development and optimization of ore processing technology. Both at existing and projected processing plants and metallurgical plants.
2. Improvement of ecological indicators.
3. Complex use of raw materials with the use of modern hydrometallurgical technologies.
4. Improving the quality of flotation concentrates.
5. Development of enrichment technologies for processing stale tailings of processing plants.
6. Extraction of valuable components from metallurgical production waste.
7. Testing of modern flotation reagents, extractants and sorbents for the development of effective technologies for the enrichment and extraction of valuable components.
8. Creation of effective binder systems for various purposes: pelletizing (production of pellets and agglomerate), briquetting (of ore concentrates and coal fines), dust suppression, etc.

DEVELOPMENT AND OPTIMIZATION OF ORE PROCESSING TECHNOLOGY.

Main goals and objectives:

- studies of ferrous, non-ferrous and rare metals ore and other mineral raw materials for enrichment by mechanical and hydrometallurgical methods.
- development of new and improvement of existing technologies for processing mineral raw materials on the basis of accumulated experience in studying the enrichment of ores and the features of mineral separation processes based on modern methods of material composition analysis

Research works:

- Mineralogical studies of ores;
- Study of the material composition of ores;
- Analysis of existing technology;
- Improvement of qualitative and quantitative indicators;
- Development of complex combinedtechnological schemes of enrichment;
- Development of technological regulations;
- Introduction of technologies in production;

INNONATIVE SOLUTIONS OF THE COMPANY

1. Development of binding additives for the production of pellets, briquetting and agglomeration of iron ore raw materials, ores of non-ferrous and rare metals.

2. Development of products to increase the hot strength of the agglomerate

3. Development of binding additives for briquetting coal dust and fines.

4. Dedusting and dust suppression at various mining and construction sites.

5. Creation of rheological additives for the needs of the construction and mining industries.

6. Technologies allowing to reduce energy consumption for filtration of intermediates and pumping of landfill waste of enrichment to tailings.

BINDERS FOR THE PELLET

In the period from 2005 to 2008, our team was developing binder additives for the production of pellets of a new type based on polymers and polymer-mineral compositions.
The work was successfully resumed in 2020.

For several years of experiments at the facilities of some mining companies, a universal binder has been created that can be used on any iron ore concentrate.The binder of our company can be used as the only binder, instead of bentonite clay.

Table 1. Results of laboratory tests on the use of polymer-mineral binder on ordinary, magnetite concentrate.

№ experience	Wet initial concentrate, %	Consumption bentonite %	Consumption PST binder %	Wet raw pellets %	Strength raw pellets R, kg/pellet.	Strength raw pellets number drops.	Poro-sity %	Strength dry pellets kg/pellet	Mass fraction of the size class (mm),% 14	-14 12	-12 10	-10 8	-8 5	-5 0	D equiv., mm	t C shock	burning layer on conveyor	Strength burn kg/pellet	abrasion resistance mini drum , % B+5	B-0,5	Poro-sity %	Chem. composition of burnt pellets mass fraction, % Fe general content	FeO	CaO	SiO_2	basicity
1	9,79	0,6	-	9,2	1,76	4,2	30,75	4,68	12,4	51,8	18,6	13	3,3	0,9	11,51	735	top	280,2	96,9	3,1	21,05	63,2	0,74	0,68	8,54	0,11
Binder - Bentonite	9,79	0,6	-	9,07	1,84	4,9		4,96	13,2	55,4	14,4	14,1	2,6	0,3	11,9		middle	278,2	96,4	3,6	20,7	63,3	1,58	0,7	8,47	0,113
	9,79	0,6	-	9,14	1,8	4,55	30,75	4,82	12,8	53,6	16,5	13,55	2,95	0,6	11,71	735	bottom	279,5	96,6	3,4	21	63,3	1,43	0,69	8,46	0,112
Binder PST-1	9,79	-	0,03	8,99	2,11	3,7	29,07	1,66	28,1	47,1	11,8	11,5	1,2	0,3	12,55	785	top	363,9	96,2	3,8	21,73	63,5	0,6	0,64	8,1	0,111
	9,79	-	0,03	8,74	2,06	3,7		1,48	24,2	52,9	12,9	8,4	1,3	0,3	12,56		middle	361,3	95,9	4,1	20,87	63,5	0,81	0,72	8,07	0,121
	9,79	-	0,03	8,87	2,09	3,7	29,07	1,57	26,15	50	12,35	9,95	1,25	0,3	12,56	785	bottom	362,3	96	4	21,3	63,5	0,88	0,71	8,11	0,119
Binder PST-2	9,69	-	0,03	8,79	1,96	3,3	30,15	1,78	32	44,5	11,6	10,4	1,2	0,3	12,7	760	top	395,4	96,3	3,7	19,7	63,5	1,37	0,68	8,14	0,115
	9,69			8,67	1,7	3,7		1,69	51,6	33,3	6,5	7,1	1,2	0,3	13,46		middle	381,2	96,3	3,7	20,14	63,6	1,18	0,6	8,14	0,106
	9,69			8,73	1,83	3,5	30,15	1,74	41,8	38,9	9,05	8,75	1,2	0,3	13,08	760	bottom	388,2	96,2	3,8	20,53	63,6	1,34	0,62	8,13	0,108
Binder PST-4	9,69	-	0,03	8,93	1,76	3,2	31,19	1,58	34,4	44,9	10,8	8,5	1,1	0,3	12,87	785	top	354	96,5	3,5	21,54	63,8	0,98	0,56	8,13	0,101
	9,69			8,91	1,82	3,5		1,66	26,8	47	15	10	0,9	0,3	12,55		middle	354,2	96,5	3,5	21,81	63,9	1,56	0,58	8,16	0,103
	9,69			8,92	1,79	3,35	31,19	1,62	30,6	45,95	12,9	9,25	1	0,3	12,71	785	bottom	342,4	96,5	3,5	22,05	63,8	1,37	0,57	8,17	0,101

Pelletizing was carried out on a magnetite concentrate, the consumption of limestone in the charge was 0.8% by weight of the concentrate

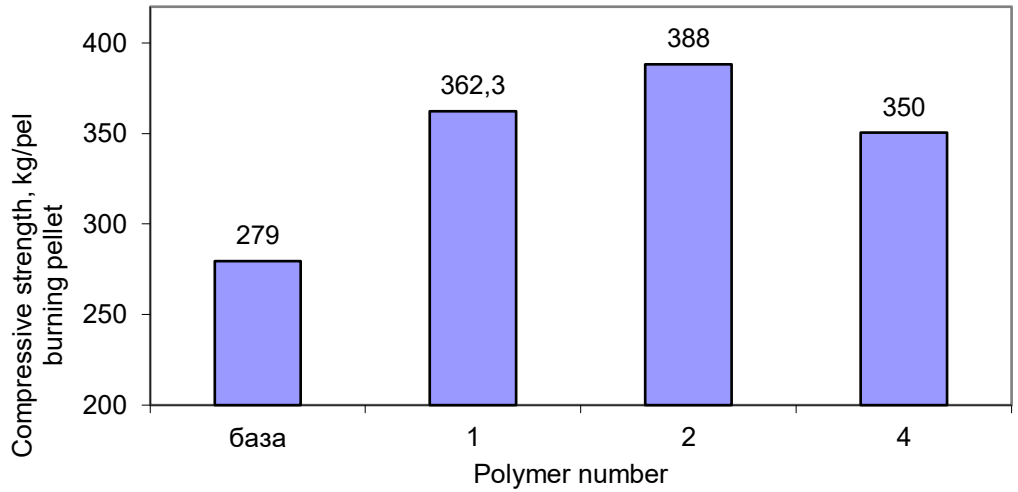

Table No.2. The results of laboratory tests on the use of polymer-mineral binder mixed with Greek bentonite.

№ experience	Wet initial concentrate, %	Consumption bentonite %	Consumption PST binder %	Wet raw pellets %	Strength raw pellets R, kg/pellet.	Strength raw pellets number drops.	Poro-sity %	Strength dry pellets kg/pellet	Mass fraction of the size class (mm),% 14	-14 12	-12 10	-10 8	-8 5	-5 0	D equiv., mm	t C shock	burning layer on conveyor	Strength burn kg/pellet	abrasion resistance mini drum , % B+5	abrasion resistance mini drum , % B-0,5	Poro-sity %	Chem. composition of burnt pellets mass fraction, % Fe general content	FeO	CaO	SiO_2	basicity
	10,2	0,4	-	9,24	1,91	3,6	29.73	5,39	15,8	45,1	17,4	17,1	4,3	0,3	11,6	735	top	296,7	96,4	3,6	22,15					
		0,4	-	9,3	1,92	4,3		5,54	19,2	48,3	16,1	12,9	3,2	0,3	11,98		middle	290,4	96,5	3,5	22,14					
	10,2	0,4	-	9,27	1,92	3,95	29.73	5,47	17,5	46,7	16,75	15	3,75	0,3	11,79	735	bottom	293,2	96,2	3,8	21,91					
Binder PST-1	10,2	0,4	0,02	8,9	2,01	1,7	30.67	3,86	70,6	24,5	3,2	1,4	0,3	-	14,75	785	top	326,6	96,5	3,5	21,32					
		0,4	0,02	8,81	2,06	2,3		3,52	51,5	35,7	7,8	4,7	0,3	-	13,86		middle	322,5	96,7	3,3	21,85					
	10,2	0,4	0,02	8,86	2,04	2	30.67	3,69	61,05	30,1	5,5	3,05	0,3	0	14,3	785	bottom	324,2	96,7	3,3	21,75					
Binder PST-2	10,16	0,4	0,02	9,4	1,81	2,9	30.37	3,15	28,4	42,4	13,7	11,9	3,3	0,3	12,25	785	top	316,6	96,8	3,2	22,68					
		0,4	0,02	9,24	1,82	2,7		3,83	25,2	44,4	15,6	11,2	3,3	0,3	12,17		middle	321,3	96,8	3,2	22,71					
	10,16	0,4	0,02	9,32	1,82	2,8	30.37	3,49	26,8	43,4	14,65	11,55	3,3	0,3	12,21	785	bottom	318,2	96,7	3,3	22,32					
Binder PST-4	10,16	0,4	0,02	9,27	1,9	3,4	30.27	4,25	53	31,5	6,1	8,3	1,1	-	13,64	760	top	319,3	97,1	2,9	21,57					
		0,4	0,02	9,2	1,86	3,7		3,95	54,7	27,6	8,7	7,2	1,8	-	13,57		middle	3,4	97	3	23,04					
	10,16	0,4	0,02	9,24	1,88	3,55	30.27	4,1	53,85	29,55	7,4	7,75	1,45	0	13,6	760	bottom	328,3	97	3	22,45					

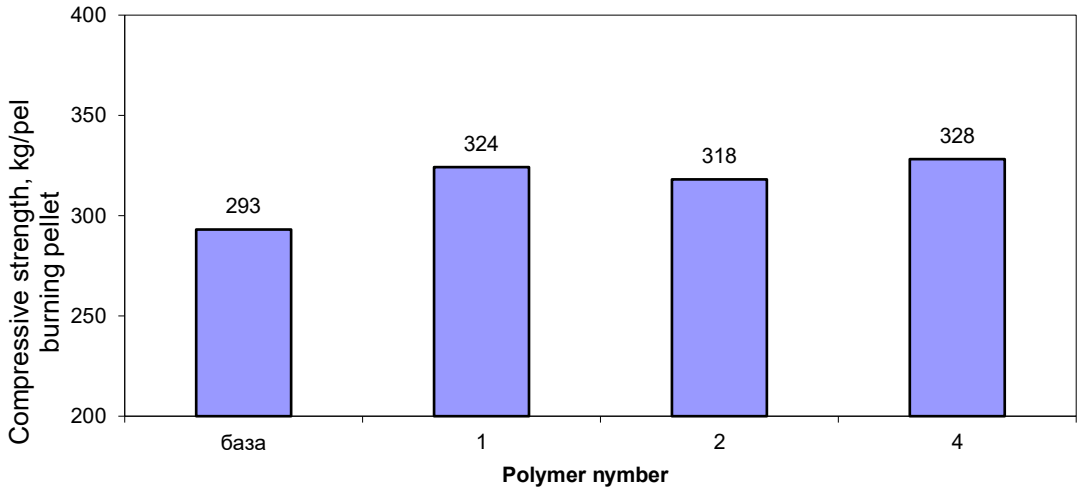

Table No. 3. The results of laboratory tests on the use of polymer-mineral binders on the flotation concentrate.

№ experience	Wet initial concentrate, %	Consumption bentonite %	Consumption PST binder %	Wet raw pellets %	Strength raw pellets R, kg/pellet.	Strength raw pellets number drops.	Porosity %	Strength dry pellets kg/pellet	Mass fraction of the size class (mm),% 14	-14 12	-12 10	-10 8	-8 5	-5 0	D equiv., mm	t C shock	burning layer	Strength burn kg/pellet	abrasion resistance mini drum , % B+5	B-0,5	Porosity %	Chem. composition of burnt pellets mass fraction, % Fe general content	FeO	CaO	SiO_2	basicity
Bentonite	9,9	0,6	-	9,32	1,47	3,4	34,95	4,28	71,2	25	2	1,5	0,3	-	14,8	785	верх	289	95,7	4,3	25					
	9,9	0,6	-	9,41	1,54	3,2		4,68	79,8	18,4	0,9	0,6	0,3	-	15,17		серед	271,5	96	4	24,35					
	9,9	0,6	-	9,37	1,51	3,3	34,95	4,48	75,5	21,7	1,45	1,05	0,3	-	14,98	785		289,1	95,8	4,2	24,79					
Binder PST-1	9,8	-	0,03	9,41	1,62	2,5	32,82	0,76	56,8	33,4	4,3	5,2	0,3	-	14,08	785	верх	335,2	95,7	4,3	24,12					
	9,8	-	0,03	9,71	1,59	2,9		0,83	63,8	28,8	3,7	3,4	0,3	-	14,4		серед	355,7	95,4	4,4	24,63					
	9,8	-	0,03	9,56	1,61	2,7	32,82	0,8	60,3	31,1	4	4,3	0,3	-	14,24	785		345,6	95,3	4,7	24,58					
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Binder PST-2	9,9	-	0,03	9,19	1,54	2	32,43	0,88	43,4	47,1	5,8	3,4	0,3	-	13,76	735	верх	357,4	96,2	3,8	24,73					
	9,9	-	0,03	9,01	1,34	2,7		0,88	62,3	29,9	4,5	3	0,3		14,36		серед	344,6	95,5	4,5	24,49					
	9,9	-	0,03	9,1	1,44	2,35	32,43	0,88	52,85	38,5	5,15	3,2	0,3	-	14,06	735		351,1	95,7	4,3	25,01					
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Binder PST-4	9,8	-	0,03	9,36	1,28	2,3	34,56	0,92	49,3	36,6	6,2	7	0,9		13,63	785	верх	333,6	96,2	3,8	24,44					
	9,8	-	0,03	9,52	1,45	1,9		0,82	60,5	30,6	5	3,3	0,6	-	14,23		серед	321,4	96	4	25,02					
	9,8	-	0,03	9,44	1,37	2,1	34,56	0,87	54,9	33,6	5,6	5,15	0,75	-	13,93	785		325,8	96,5	3,5	24,94					
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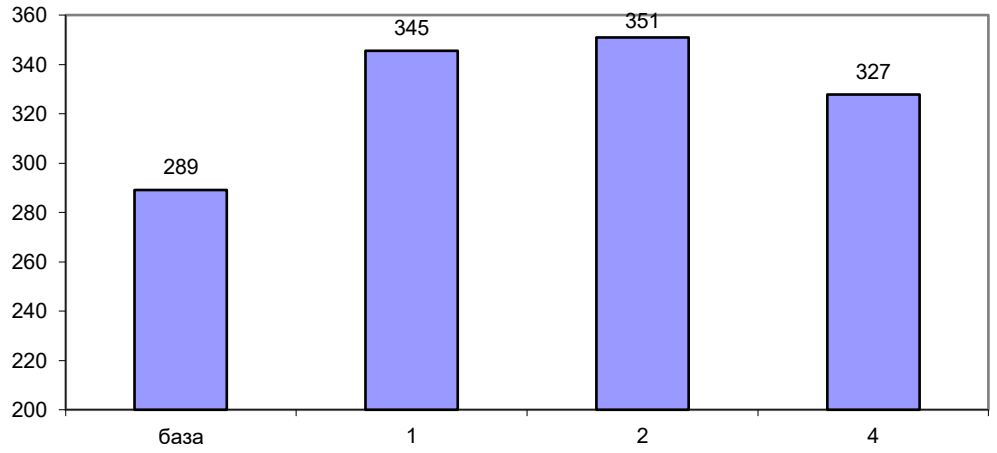


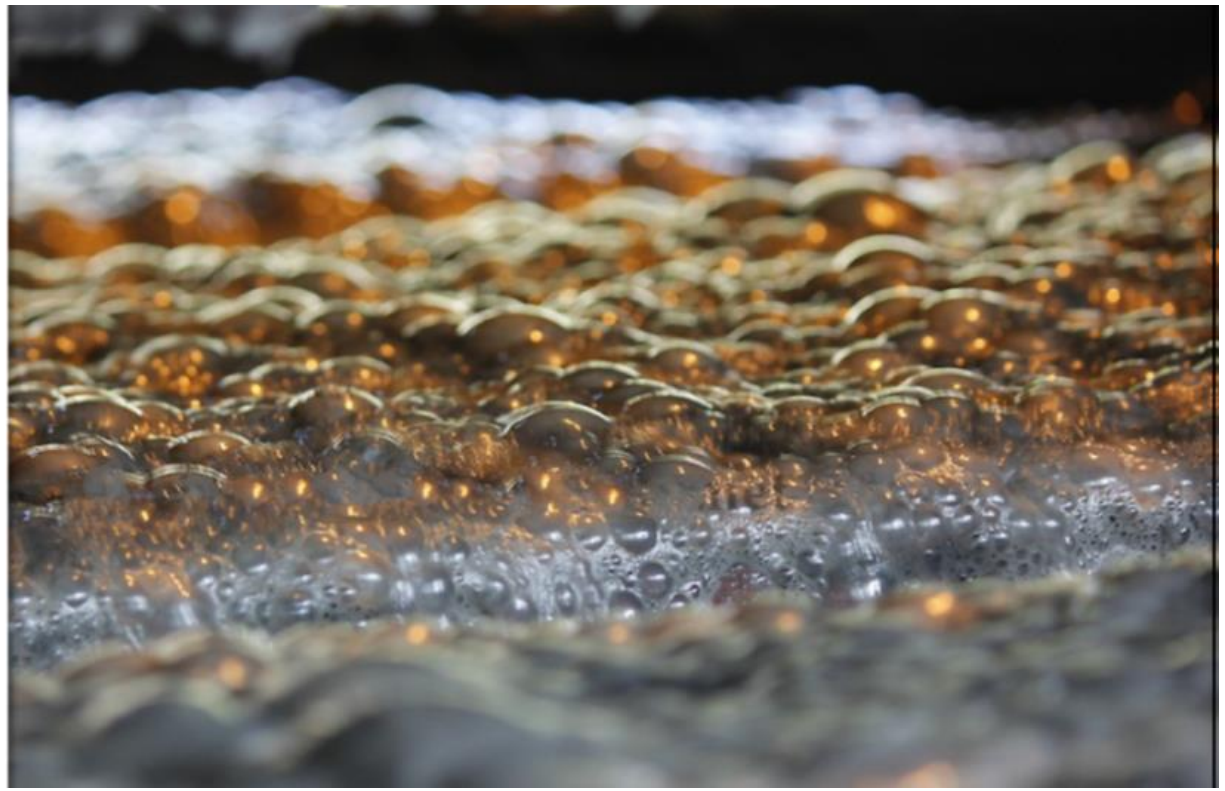
The main difference of our binder –

- Our product is a synergistic combination of components in a polymer-mineral composition.
- Some of the components ensure the correct formation of the pellet. The other part works at the high-temperature firing stage and ensures the achievement of high strength characteristics at the firing stage. The product is used with low consumption (300-400 grams per ton of pellets) without adding traditional bentonite binder.

During the industrial tests of the trial batch of binder, high results were achieved: satisfactory strength of raw pellets, stable granulation, porosity, and high strength of fired pellets without the use of bentonite clay.

OUR PARTNERS IN THE FIELD OF FLOTATION ENRICHMENT OF MINERAL RAW MATERIALS

Flotec provides equipment and highly qualified human resources for the study of ore dressing processes. Ore crushing processes, classification, magnetic, gravity and flotation enrichment



TECHNOLOGICAL LABORATORY

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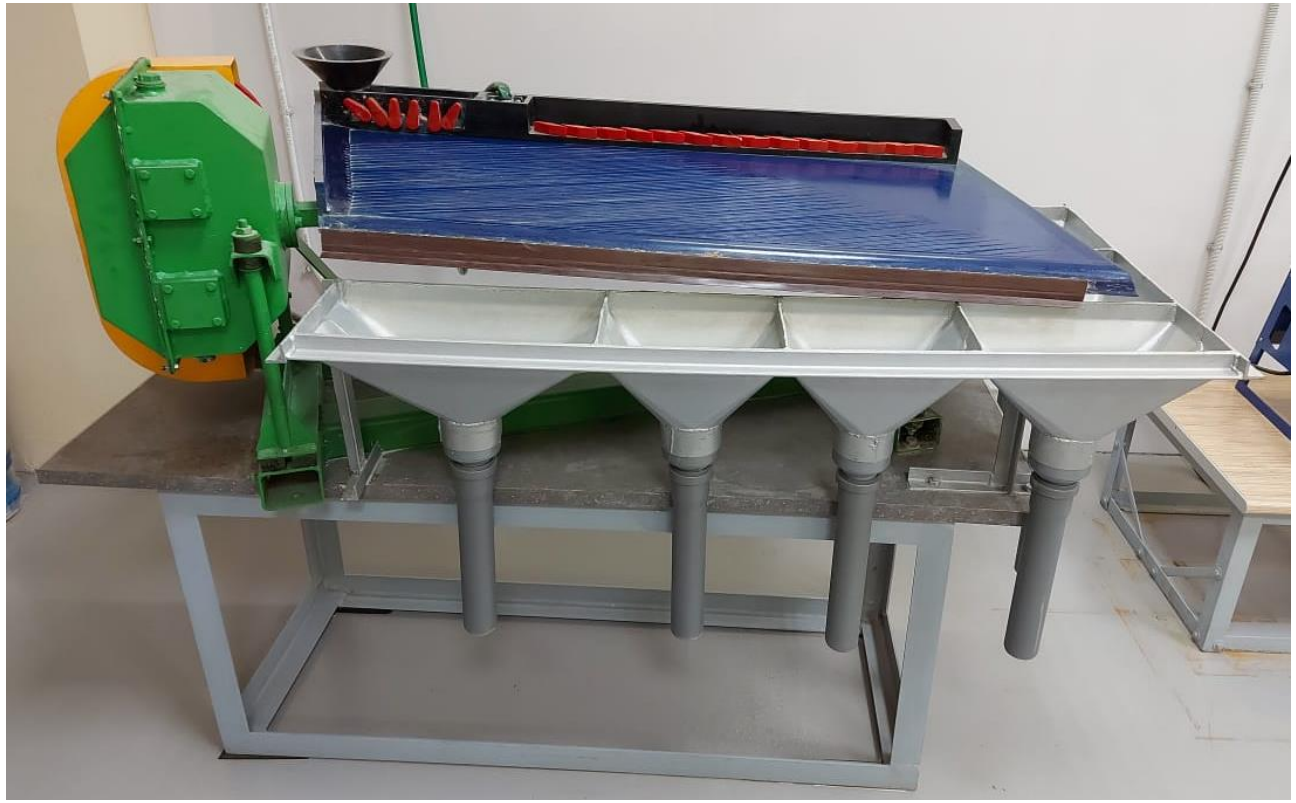

THE MAIN TYPES OF LABORATORY RESEARCH:
Studies of the mineralogical composition of ores and enrichment products

Ore preparation:

- determination of ore crushing capacity-
- determination of the propensity of ores to self and semi-self-grinding processes
- determination of the pulverizability of ores

Enrichment:

- gravity methods of enrichment
- flotation methods of enrichment of ores and stale tailings of previous years of processing- magnetic enrichment methods
- determination of parameters for thickening and filtration processes- hydrometallurgical studies

Members of the Powersteel Technology Team participated in the following works:

1. Technology development

1.1. Rhenium extraction during processing of molybdenum concentrates processing with nitric acid.
1.2. Extraction of rhenium from sulfuric acid scrubber solutions during the firing of copper and copper-nickel ores.
1.3. Separation of perrenate and molybdenum ions in concentrated solutions.
1.4. Extraction and separation of lanthanum and lanthanides from solutions of complex composition.
1.5. Creation of polymer-mineral binders for iron ore pellets.
1.6. Creation of complex adhesive and water-retaining additives for building materials.
1.7. Creation of products to increase the hot strength of the agglomerate.
1.8.Creating binders for coal fines.
1.9.Creating products for dust suppression

2. Technological research

2.1. Copper-nickel ores of Norilsk and Talnakh ehrichment plant;
2.2. Copper-zinc ores of the Gayskoye deposit (ore body N6, N7);
2.3. Copper-molybdenum ores of the Mikheevsky deposit;
2.4. Copper-zinc ores of the Summer deposit;

3. Participation in the design

3.1. ehrichment plant of the Natalka deposit;
3.2. ehrichment plant of the Vertical deposit;
3.3. ehrichment plant of the Jeruy deposit;
3.4. ehrichment plant of the Troitskoye field;
3.5. ehrichment plant the Volkovkskoye field;
3.6. ehrichment plant of the Pravoberezhnoye deposit;

4. Participation in installation supervision and commissioning works

4.1. EP1 of Lomonosov MEP

4.2. Krasnobrodsky coal mine

4.3. Nyurbinsky MEP of company Alrosa

5. Industrial testing of reagents and equipment

5.1. Pechenganikel.

5.2. Karelian pellets.

5.3. Mine Matrosova.

5.4. UZKTZHM, Chirchik.

6. Introduction into industrial use

6.1. Systems of binders and film-forming.

6.2. Base oils and additives for oils and coolant (Rosneft, Lukoil...)

6.3. Surfactants for various applications.

We carry out our own developments and are looking for partners.

If you want to be present on the Russian market and want to sell your technologies and know-how here, we are ready to be your partner.
Hydrogen energy and carbon footprint. If you have commercial offers in these areas, we are ready to participate in the promotion of your offers on the Russian market.

“Powersteel technology”

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