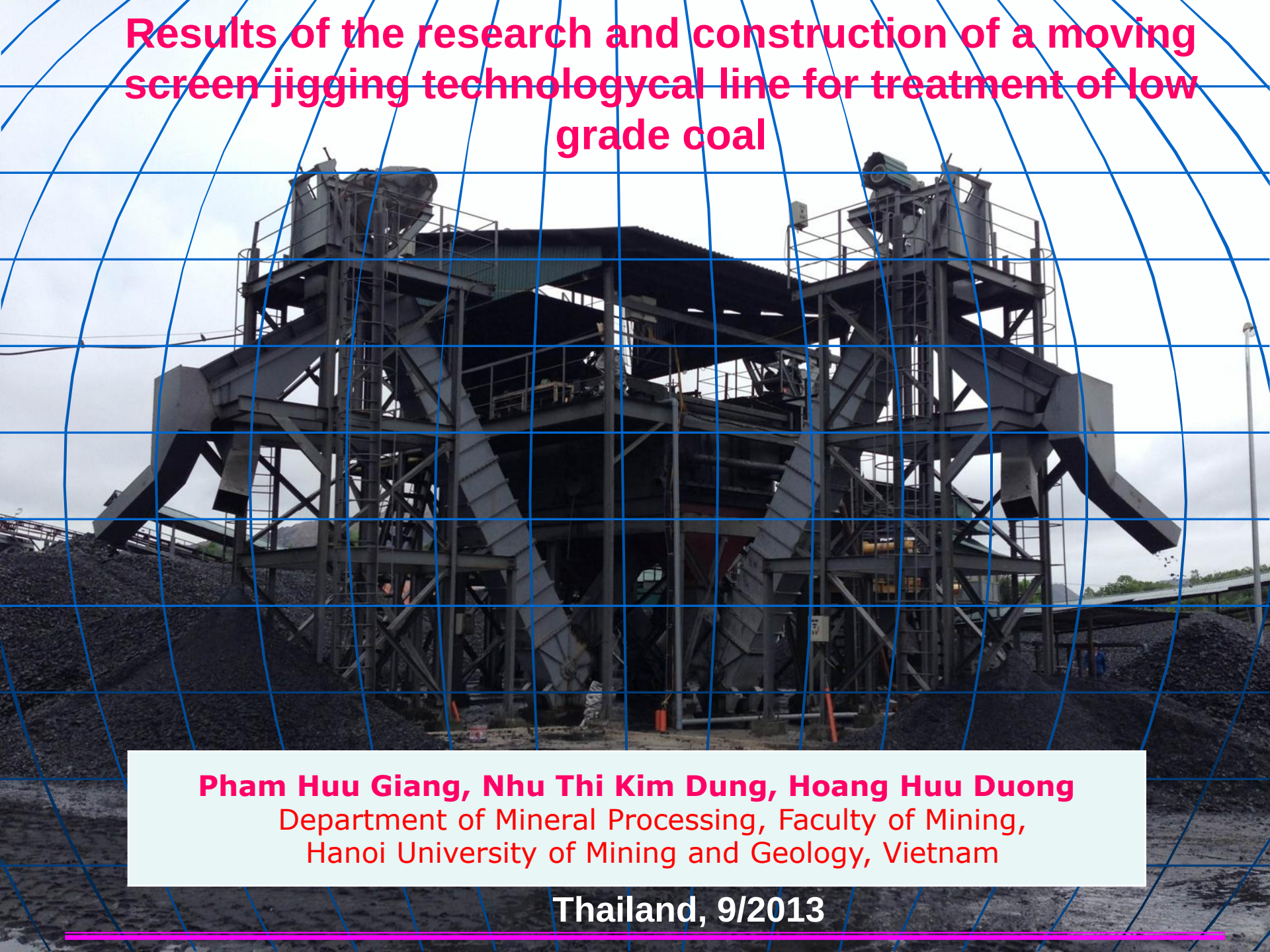
Results of the research and construction of a moving screen jigging technologycal line for treatment of low grade coal



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Thailand, 9/2013

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ABSTRACT

A large quantity of low grade coal (ash content of more than 50%) is generated in mining process at mines in Vietnam. The coal is untreated and annual production may reach millions of tons. The non-commercial coal is accumulated in large stockpiles so causing severe pollution to environment and significant loss of coal reserves. The paper presents results of experiments of pilot scale using moving screen jig to treat the coal of size range 3- 15mm; 6- 35mm and 6- 50 mm. Also outcomes of first two industrial lines using this technology for coal sizes of 6- 35mm and 6- 80 mm are reported.

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1. INTRODUCTION

The mining production of Vietnam increases continuously in the first years of 21 century, namely 12,200,000 tons in 2000, 39,124,000 tons in 2006, 43,963,000 tons in 2007, and 46,963,000 in 2010. During 10 years of mining was registered an increase of 285%. The more the production increases the more the low grade coal of ash content from 50 to 70% is stocked. Every year at each mine was estimated an average of 200,000 tons to 500,000 tons of low grade coal to cause the loss of coal reserves, decrease in effectiveness of mining, and pollution to environment.

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In order to recover fully this coal there are production lines working at mining plants using the following equipment: magnetic suspension drum separators, magnetic suspension cyclones, autogenous suspension separators, inclined conveyors, pneumatic tables, and moving screen jigs. Recently two production lines using moving screen jig have been set up and results of investigation, design and erection of these lines are reported.

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2. RESULTS OF EXPERIMENTS USING SEMI-INDUSTRIAL MOVING SCREEN JIG

2.1 Samples

Samples of low grade coal from Ha Tu mine and class -50 +15mm from Tan Lap mine are collected and analysed to determine its size characteristics and ash content, and results are presented in Tables 1 and 2.

Tab. 1 Sample from Ha Tu mine

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Size fraction, (mm)	Yield, (%)	Ash, (%)
> 35	16.40	84.80
15 - 35	12.97	81.74
6 - 15	13.15	66.60
3 - 6	12.90	58.93
1 - 3	14.49	51.28
0.5 - 1	9.26	45.00
0 - 0.5	20.83	37.81
Feed	100.00	60.34

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Tab. 2 Sample from Tan Lap mine

Size fraction, (mm)	Yield, (%)	Ash, (%)
35 – 50	2.73	78.01
15 – 35	45.66	62.15
6 – 15	30.75	33.64
3 – 6	6.44	27.87
0.5 – 3	7.65	32.84
0 – 0.5	6.77	41.63
Feed	100.00	47.98

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From data of these tables some comments may be drawn:

For Ha Tu mine:

- The class -6mm has a yield of 57.48 % and the ash content of 6.7 %. The yield of class +15 mm is of 29.37 % and the ash content is of 83.45 %, this class could be considered as refuse.

For Tan Lap mine:

- The class -6mm has a yield of 20.86 % and the ash content of 34.16 %. The yield of class +15-50 mm is of 51.62 %.

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2.2 Experimental results

The semi-industrial moving screen jig shown in Fig.1 has a capacity of 3 – 5 tons/h and the maximum feeding size of coal is 50mm. The design of jig allows to select one of two product options depending on the actual production and the consumer demand, i.e to obtain clean coal of ash content below 45% (upper ash content limit of fines 6b HG) and clean coal of ash content below 31% (40) (upper ash content limit of fines 5b (6a) HG).

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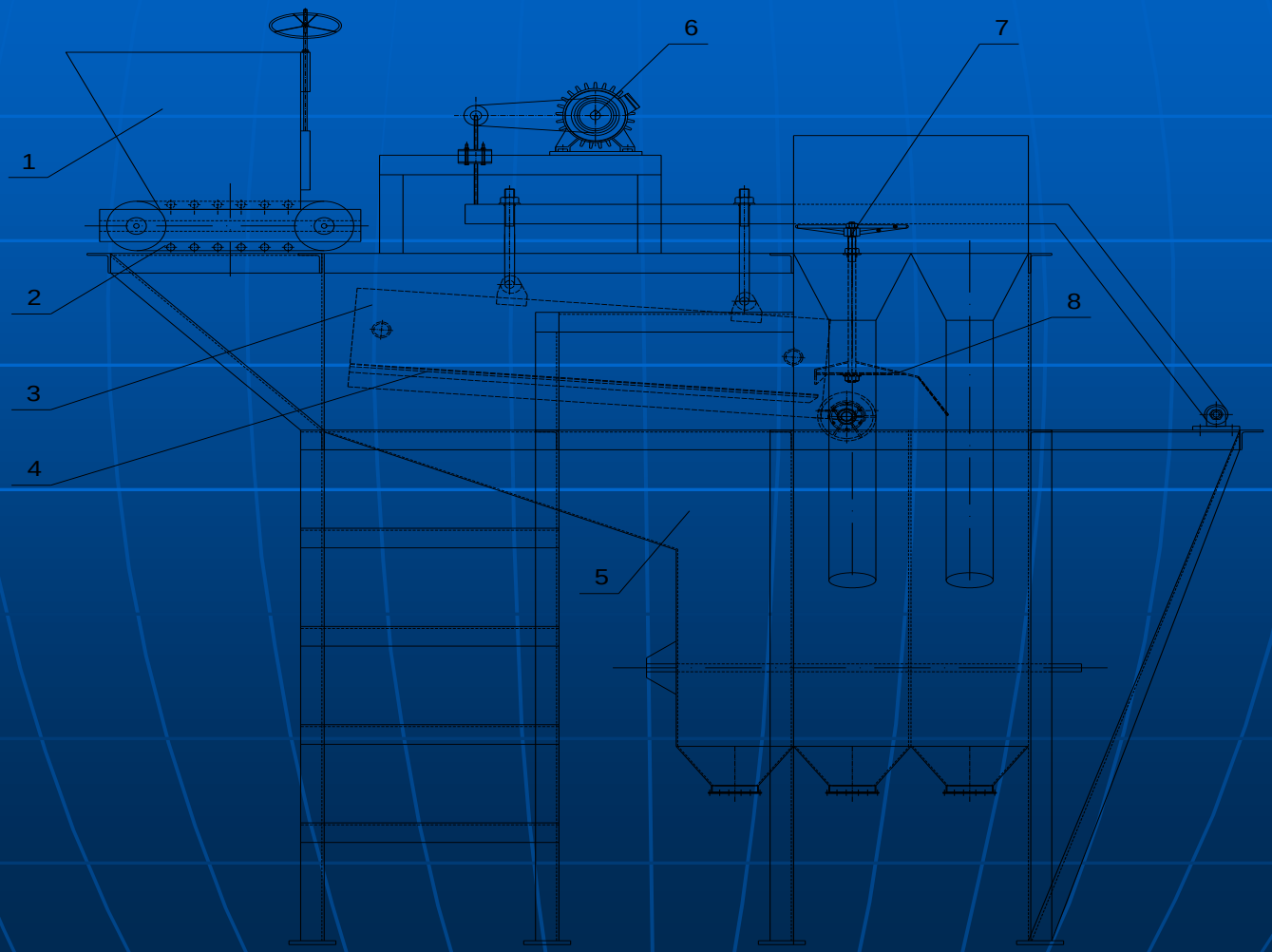

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Fig. 1 Sketch of semi-industrial moving screen jig

1.Feeding bin;

2. Feeding conveyor;

3. Screen frame;

4. Screen; 5. Jigging chamber; 6. Motor;

7. Controlling mechanism for discharge threshold;

8. Discharge threshold

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2.2.1. Testing the coal sample of Ha Tu mine

- Size fraction 6 – 35 mm

Fraction 6 - 35 mm of low grade coal from Ha Tu mine is treated in a semi-industrial moving screen jig with sieve size of 6 mm. Tests results in optimal conditions are presented in Tables 3 and 4.

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Tab. 3 Treating coal fraction 6 - 35mm to obtain clean coal of high ash content

Nº	Coal Products	Yield, (%)	Ash, (%)
1	Clean coal 6-35 mm	5.05	44.84
2	Mud coal	3.61	64.63
3	Fines 0 - 6 mm	57.48	46.70
	Subtotal coal	66.14	47.54
4	Refuse 6 - 35 mm	17.46	83.70
5	Fraction + 35 mm	16.40	84.80
	Subtotal refuse	33.86	84.23
	Feed	100.00	59.96

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Tab. 4 Treating coal fraction 6-35 mm to obtain clean coal of low ash content

Nº	Coal Products	Yield, (%)	Ash, (%)
1	Clean coal 6-35 mm	4.21	30.15
2	Mud coal	4.42	63.13
3	Fines 0 - 6 mm	57.48	46.70
	Subtotal coal	66.11	46.74
4	Refuse 6 - 35 mm	17.49	86.74
5	Fraction + 35 mm	16.40	84.80
	Subtotal refuse	33.89	85.80
	Feed	100.00	59.98

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- Size fraction 3 - 15 mm

- The size fraction 15 - 35mm of sample from Ha Tu mine has high ash content (above 80 %). This fraction of coal is either to treat to yield about 5% or to discharge as refuse because of high ash content.
- The ash content of fraction 3 - 6mm is high relatively (58.93 %) so it is could not be commercialised. It is recommended to treat a wide size range fraction 3 - 15mm for obtaining a product meeting consumer demand.
- Tests results for class 3 - 15 mm processed in semi-industrial jig (sieve size of 3mm) in optimal conditions are shown in Tables 5 and 6.

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Tab. 5 Treating fraction 3 - 15 mm to obtain clean coal of high ash content

Nº	Coal Products	Yield, (%)	Ash, (%)
1	Clean coal 3 - 15 mm	9.54	42.80
2	Mud coal	4.07	61.85
3	Fines 0 - 3 mm	44.58	43.68
	Subtotal coal	58.19	44.81
4	Refuse 3 - 15 mm	12.44	82.55
5	Fraction +15 mm	29.37	84.80
	Subtotal refuse	41.81	84.13
	Feed	100.00	61.25

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Tab. 6 Treating fraction 3 – 15 mm to obtain clean coal of low ash content

Nº	Coal Products	Yield, (%)	Ash, (%)
1	Clean coal 3 - 15 mm	6.94	36.08
2	Mud coal	4.73	59.29
3	Fines 0 - 3 mm	44.58	43.68
	Subtotal coal	56.25	44.05
4	Refuse 3 - 15 mm	14.38	81.43
5	Fraction +15 mm	29.37	84.80
	Subtotal refuse	43.75	83.69
	Feed	100.00	61.39

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2.2.2. Testing the coal sample of Tan Lap mine

Coal sample of Tan Lap mine is treated in semi-industrial moving screen jig and tests results are shown in Table 7.

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Tab. 7 Results of testing coal sample of Tan Lap mine

Products		Yield, (%)	Ash, (%)
Refuse	+ 6 mm	35.71	82.84
	- 6 mm	3.37	48.80
	Subtotal	39.08	79.90
Clean coal		43.72	27.74
Fines -6 mm		17.20	37.94
Feed		100.00	49.88

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Based on results of treating coal samples of Ha Tu and Tan Lap mines presented in Tables 3, 4, 5, 6, 7 some conclusions may be drawn as follows:

1) The processing of class 6 - 35mm of Ha Tu coal sample allows obtaining clean coal of ash content 30% to 45% with a yield of 4% to 5%. Total clean product including fines and slime has a yield of average 66% and ash content of 46% to 47%.

2) The processing of class 3 - 15mm of Ha Tu coal sample allows obtaining clean coal of ash content 36% to 43% with a yield of 6.9% to 9.5%. Total clean product including fines and slime has a yield of 56% to 58% and ash content of 44% to 45%.

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3) The processing of class 15 - 50mm of Tan Lap coal sample allows obtaining clean coal of ash content below 30% and refuse of ash content about 80%. It is possible to obtain an extra yield of fines of ash content 48.8% from refuse if a screening operation with sieve of 6mm is introduced to treat refuse from jig. In that case will be removed a +6mm refuse of ash content of above 82%.

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3. THE INDUSTRIAL MOVING SCREEN JIG

3.1. Production line for the processing of Ha Tu low grade coal

Based on the properties of accumulated low grade coal of Ha Tu mine, industrial moving screen jig washing plant of capacity 300,000 tons a year has been designed for coal size 6 - 35 mm. The technological flowsheet for the processing of low grade coal is shown in Fig.2 and the snapshot of industrial moving screen jig is presented in Fig 3. Designing data and processing results are provided in Table 8.

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The low grade coal (ash content above 60%) is feed into a double sieve screen with sieve size 6mm and 35mm. Three products obtained are: fines of size -6 mm with ash content below 55%, class +35mm (ash content above 80%) is removed as refuse, and class 6 – 35mm with ash content above 60% is introduced into a moving screen jig. To pass through a dewatering screen with sieve size 0.5mm the product of class -6mm with ash content below 55% is divided into wet fines of 0.5-6mm with ash content above 55% and slime of -0.5mm having the ash content below 50%.

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Four products received after jigging in moving screen jig are: wet fines of ash content above 55%, refuse of ash content above 80%, clean coal of ash content below 36%, and sludge of -1mm of ash content below 50%. The sludge from the jig and the slime passed the dewatering screen of sieve size 0.5mm are entered into the thickener. The settled product from the thickener is pumped to the clarifier in open air where slime is obtained and the sludge is used as circulating water.

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Fig. 2 Flowsheet for the processing of Ha Tu low grade coal

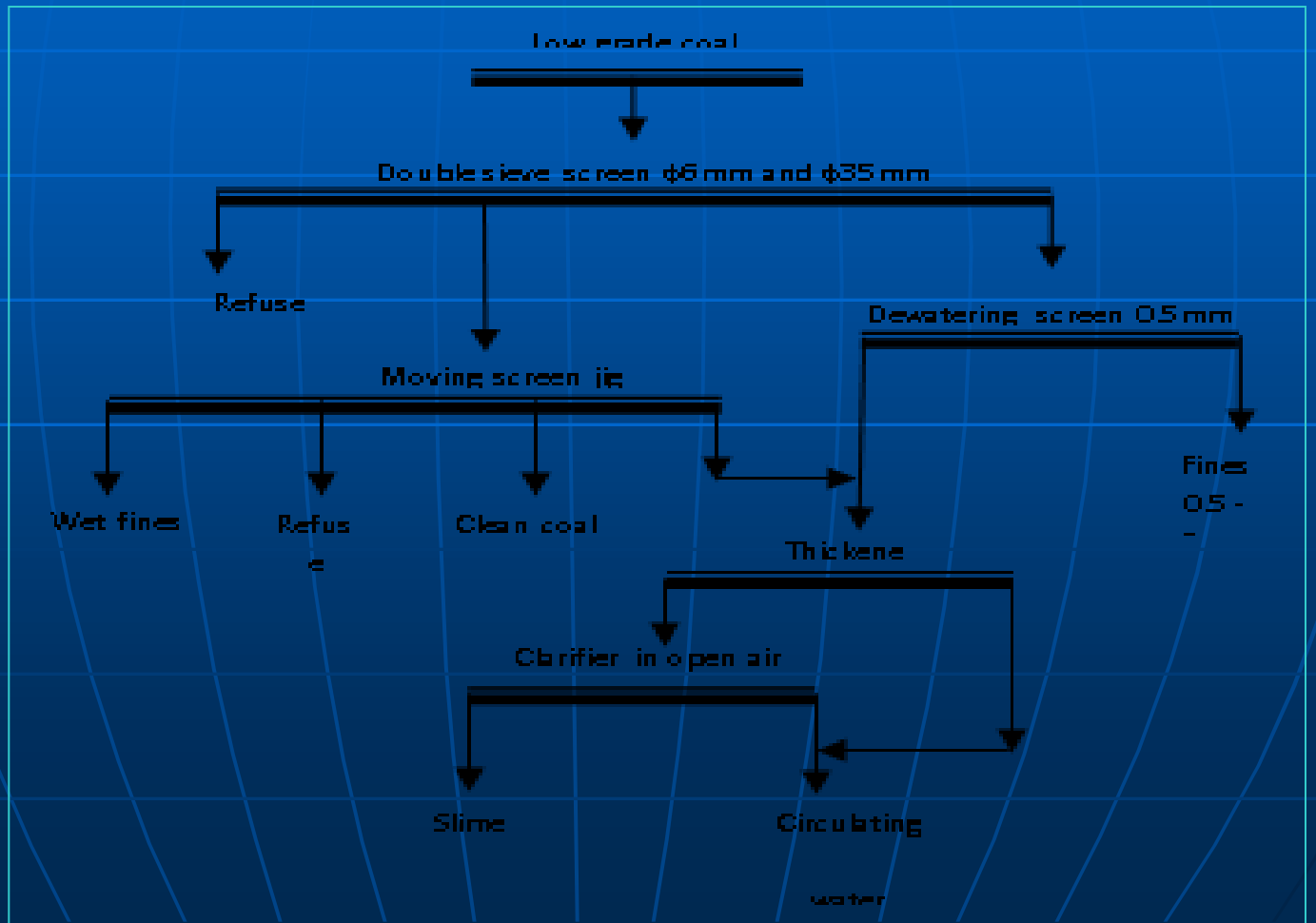

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Fig. 3 Snapshot of an industrial moving screen jig erected at Ha Tu coal mine

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Tab. 8 Designing data and working results in an industrial moving screen jig at Ha Tu mine

Product type	Products	Yield, (%)	Ash, (%)	Q, (ton/h)
Design				
Fines	Dry fines	40.24	47.10	29.05
	Wet fines	11.06	53.90	7.98
	Mud coal	9.90	46.25	7.15
	Processed fines	3.72	35.00	2.69
	Subtotal fines	64.92	47.44	46.87
Refuse	Fraction +35mm	17.70	84.56	12.78
	Refuse from jig	17.38	83.89	12.55
	Subtotal refuse	35.08	84.23	25.33
Feed		100.00	60.34	72.20
Actual production				
Clean coal			17 – 32	
Fines			62 – 64	
Refuse			81 - 90	

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3.2. Production line for the processing of Tan Lap low grade coal

The feed coal (for coal size 15-50 mm) into the moving screen jig washing plant was received from three mines. The plant has been designed for coal size 15 - 50 mm with capacity 200,000 tons a year. The technological flow sheet for the processing of low grade coal is shown in Fig. 4 and the snapshot of industrial moving screen jig is presented in Fig. 5. Designing data and processing results are provided in Table 9. The low grade coal is feed into a conveyor and passed vibrating feeder is entered into a moving screen jig. Four products received after jigging in moving screen jig are: clean coal, reject, wet fines coal 0-6mm and sludge.

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The reject into the bucket elevator is dewatered and passed the screen with size 6(10) mm the product of reject with high ash content (+6(10) mm) and high ash fines coal (0-6(10) mm). The clean coal into the bucket elevator is dewatered and is feed into a double sieve screen with sieve size 1mm and 15mm the product of clean coal 15-50mm, clean fine coal 1-15mm and fine coal -1mm. The wet fines coal 0-6mm into the bucket elevator is dewatered. The sludge from the jig and the fine coal -1mm are pumped to the clarifier in open air where slime is obtained and the sludge is used as circulating water.

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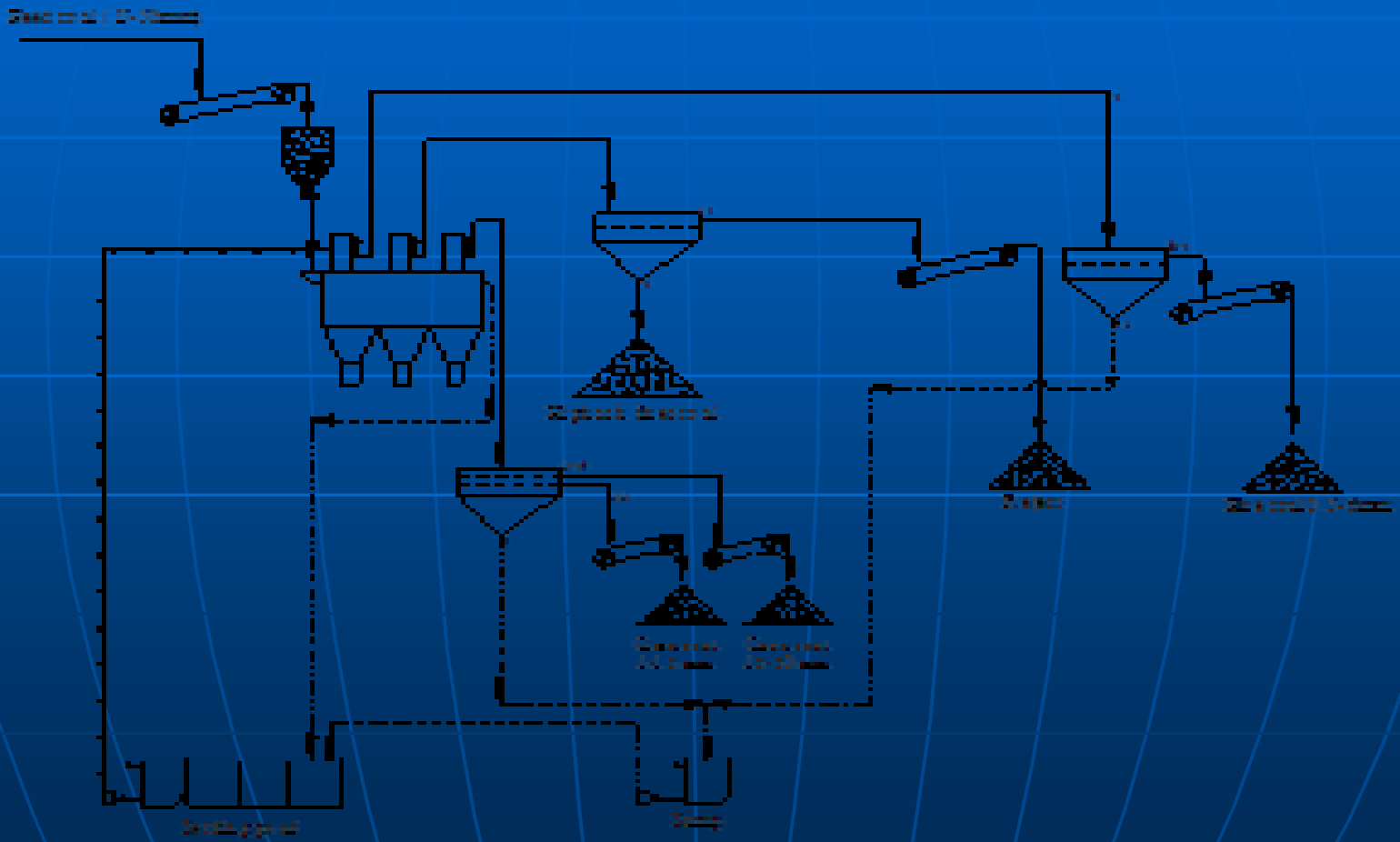

Fig. 4 Flowsheet for the processing of fraction 15-50mm of Tan Lap mine

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Fig. 5 Snapshot of an industrial moving screen jig working at Tan Lap mine

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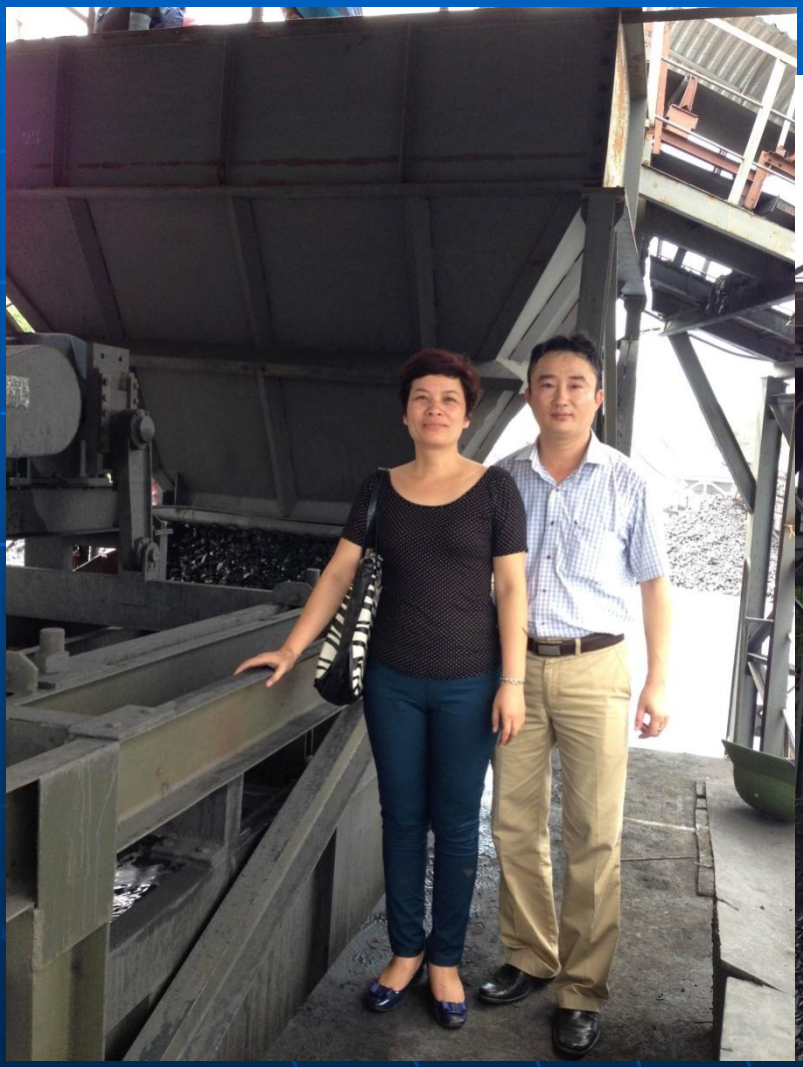

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Tab. 9 Designing data and working results in an industrial moving screen jig at Tan Lap mine

Products	Yield, (%)	Ash, (%)	Q, ton/h
Design			
Clean coal 15 - 50 mm	22.62	18.00	10.18
Fines 4ª	12.21	18.00	5.49
Fines from jig	7.59	30.57	3.41
Mud coal	9.08	41.76	4.09
High ash fine coal	3.15	40.00	1.42
Fines	45.35	79.69	20.41
Feed	100.00	49.78	45.00
Actual production			
Clean coal 6 - 50 mm		22 - 30	
Processed fines 0 - 6 mm		10 - 20	
Under screen fines 0 - 6 mm		35 - 50	
High ash fine coal 0 - 6 mm		45 - 56	
Refuse + 6 mm		77 - 80	

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4. CONCLUSIONS:

1) The industrial moving screen jig differs from ROMJIGs in the followings: the sieve is driven by an eccentric transmission; the use of flywheel having counterweight or two compression springs when the sieve is moving downward (therefore to save the power); lifting the products by bucket elevators; the possibility to lower feeding size of material to 6mm.

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2) The advantage of using industrial moving screen jig is to possibility recover fully the clean coal from low grade coal accumulated in great stockpiles at Viet Nam coal mines.

3) The clean coal has the ash content meeting Vietnam Standards TCVN. This product is to supply to thermal power plants. The refuse from jig is removed as accepted by Standards.

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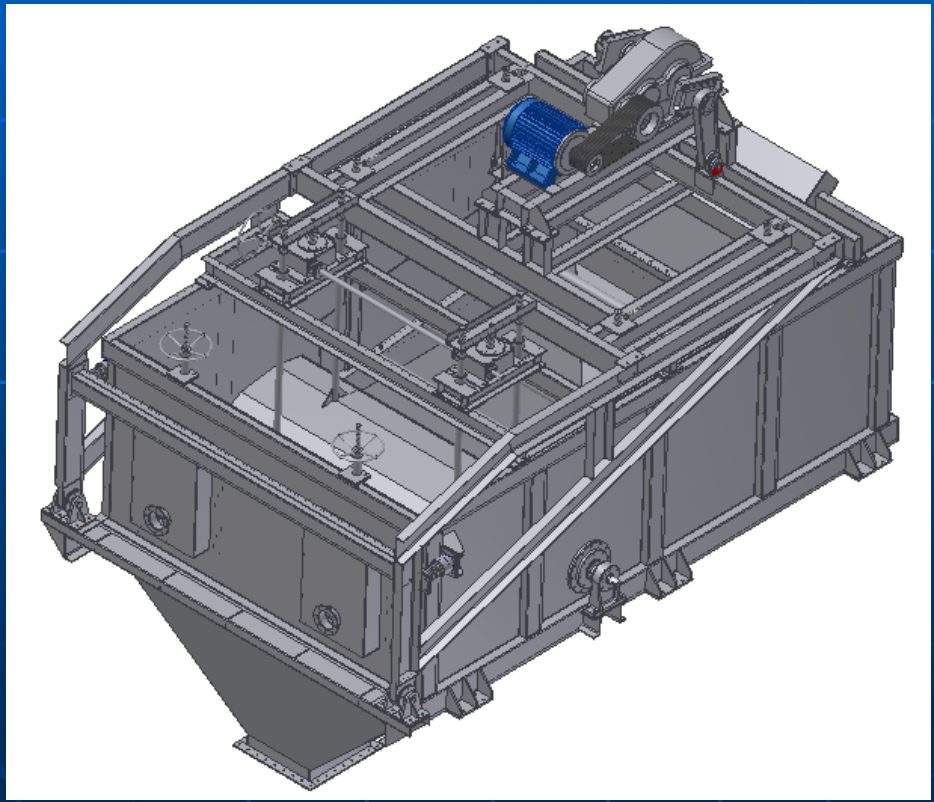
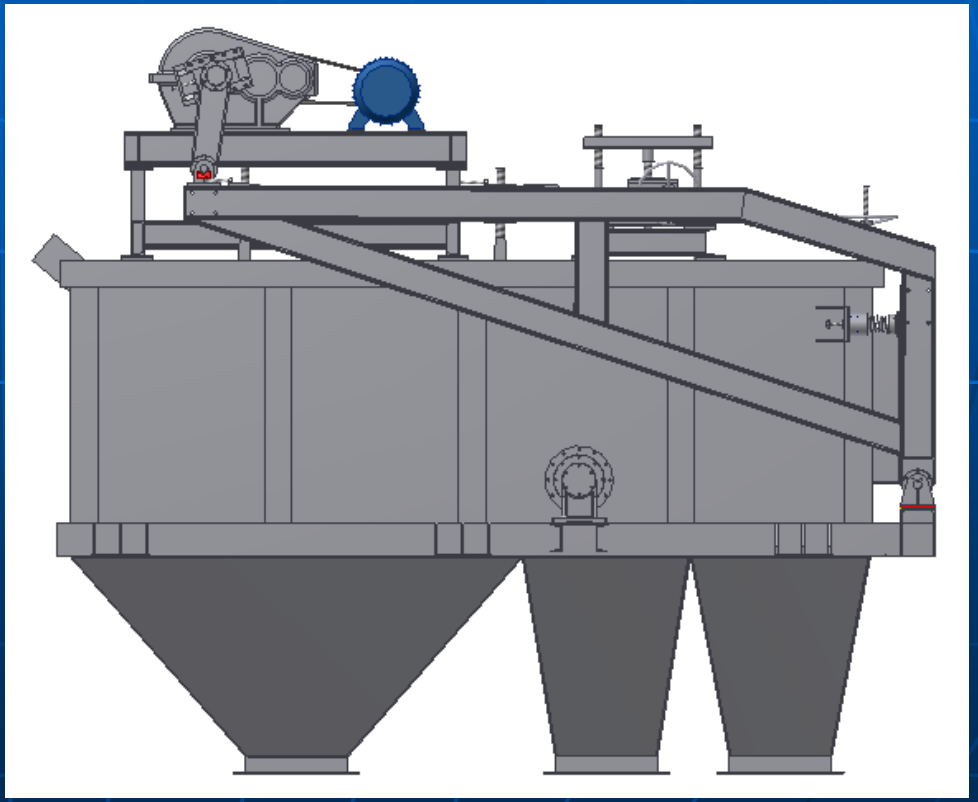
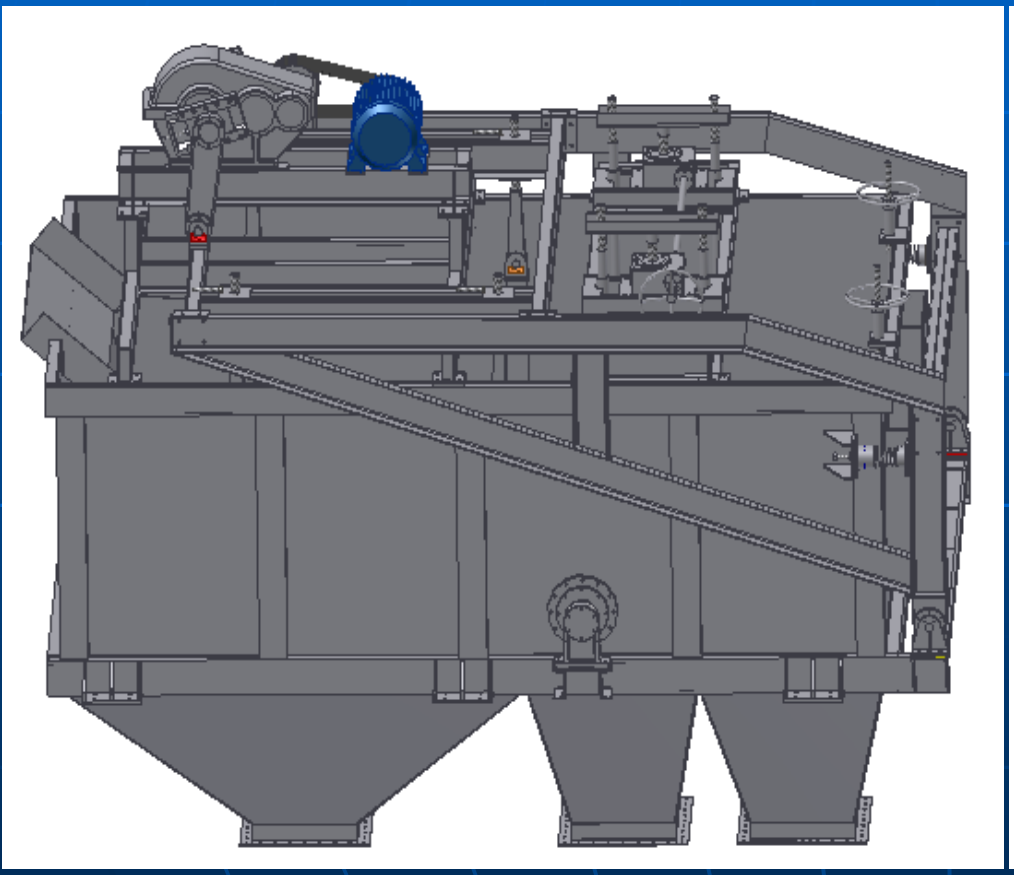
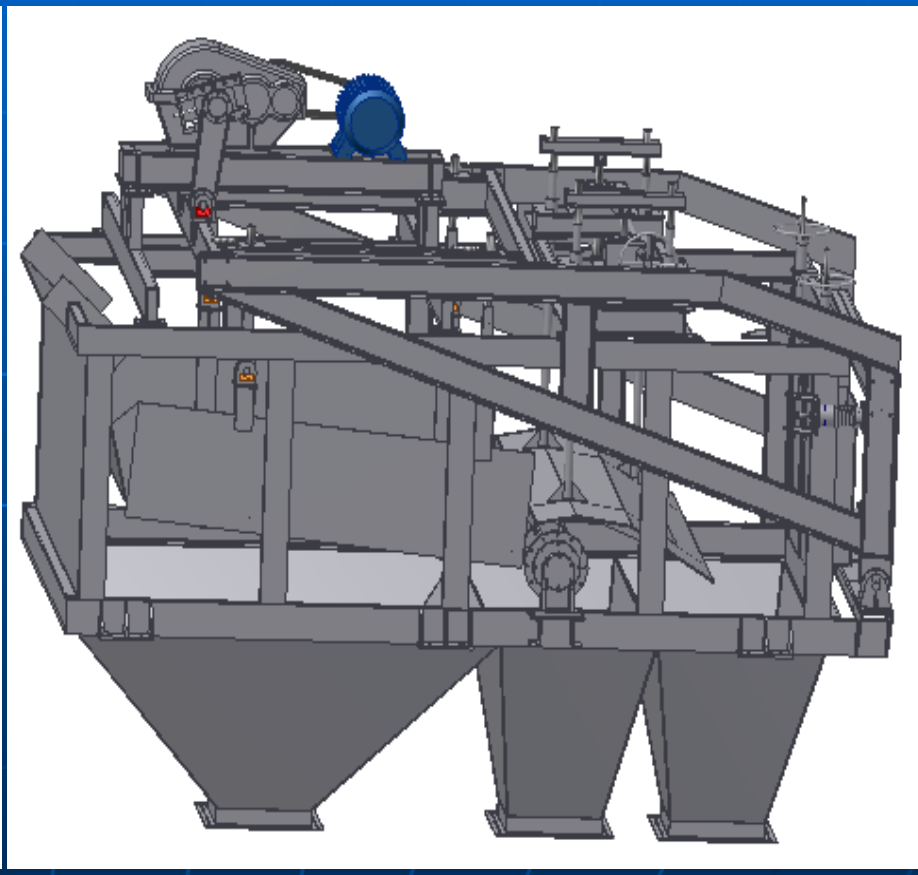
Design Moving - screen Jig





Design Moving - screen Jig





Thank you!