



National Mining University



**SELECTIVE TECHNOLOGY
OF COAL EXTRACTION
FROM VERY THIN AND THIN
SEAMS (0,55÷0,8 m)
LEAVING ROCK IN MINE**

Presenter, Prof., Dr. Tech. Sc. Volodymyr Bondarenko.

CONTENT



- 1. Analysis of industrial reserves structure**
2. Selective technology
3. Advantages of the proposed technology
4. Conclusions

EVALUATION OF COAL INDUSTRIAL RESERVES



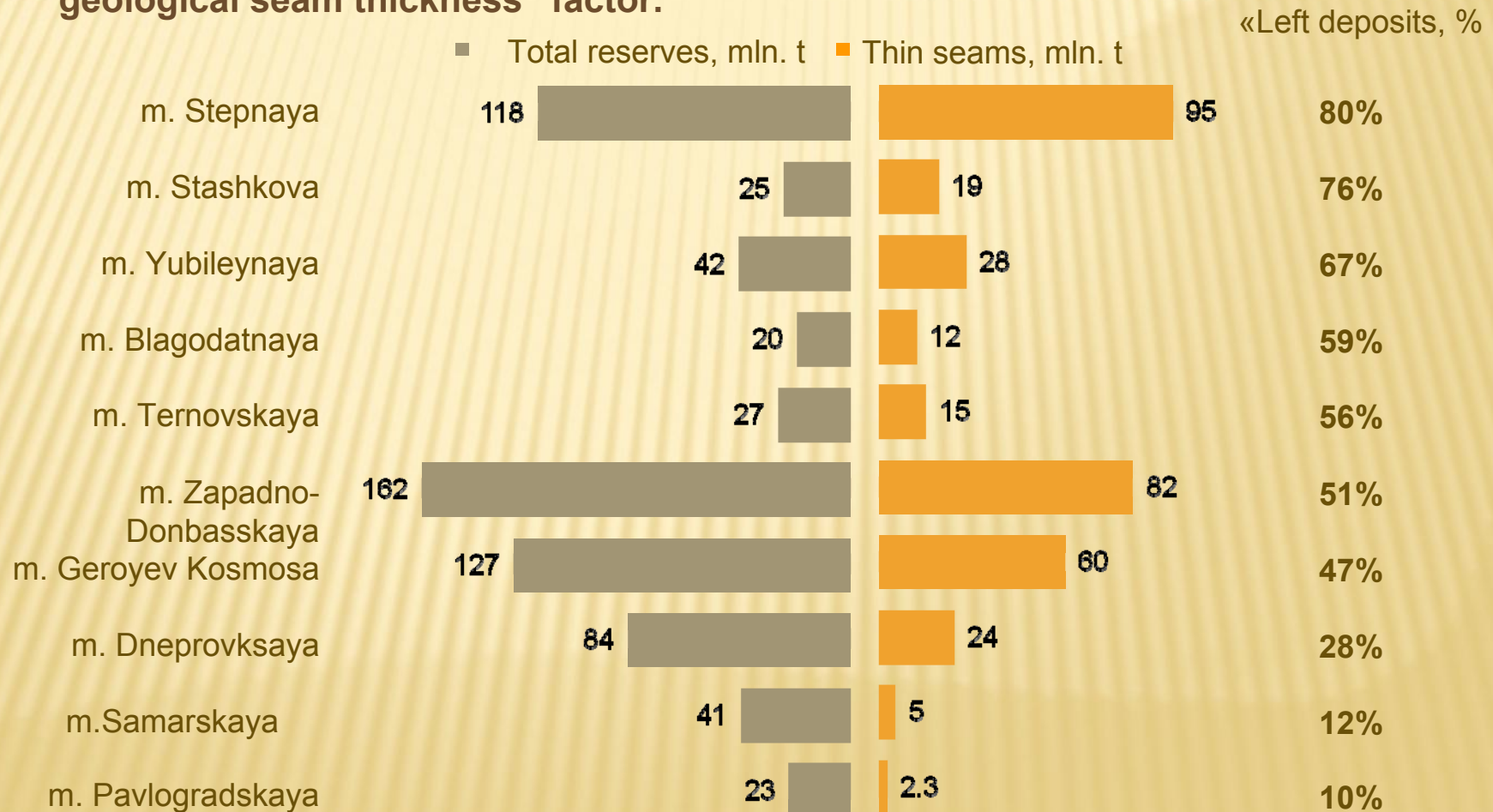
ACCORDING TO EXPERTS, COAL INDUSTRIAL RESERVES WILL BE ENOUGH FOR **150-200** YEARS IN UKRAINE (ANNUAL EXTRACTION VOLUME – 100 MLN. TONS).

BUT ABOUT **70%** OF THESE RESERVES ARE LOCATED IN COAL SEAMS WITH THICKNESS OF $0,55\div 0,8$ m

SHARE OF INDUSTRIAL RESERVES IN SEAMS WITH THICKNESS OF 55-0,8 m

In total, OJSC «DTEK Pavlogradugol» has 671 mln. t. of industrial coal reserves, and 341 mln. t. are located in thin seams.

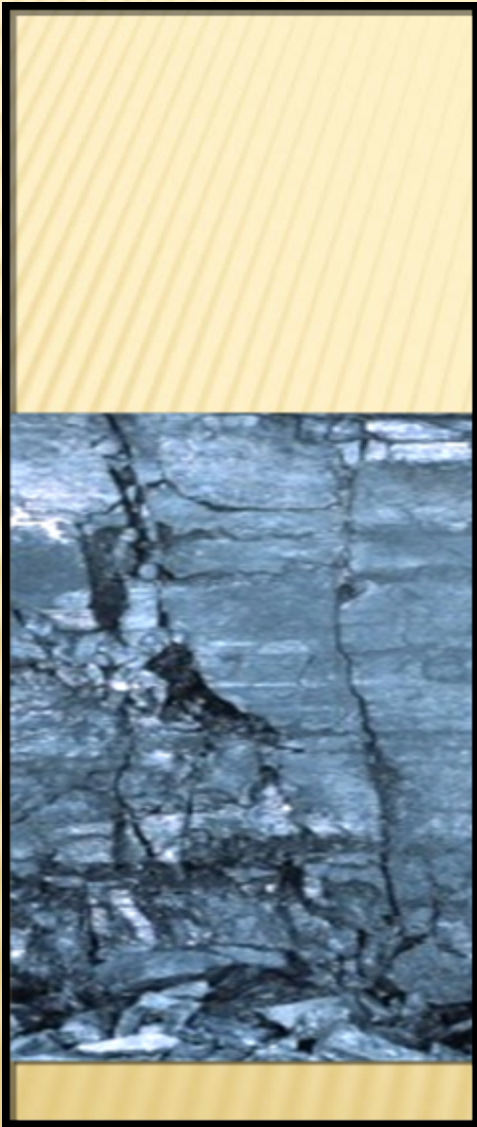
51% of these reserves are considered to be inexpedient according the “geological seam thickness” factor.



INCREASE OF MINES LIFETIME

Mine	Lifetime not involving behind-the-balance reserves, years	Lifetime involving reserves in very thin seams (0,55-0,8 m), years
Stashkova	5	20
Blagodatnaya	5	15
Ternovskaya	8	20
Yubileynaya	10	30
Stepnaya	15	80
Pavlogradskaya	15	16
Samarskaya	25	30
Dneprovskaya	40	60
Geroyev Kosmosa	45	80
Zapadno-Donbasskaya	50	110

QUALITY OF EXTRACTED COAL



USE OF EXISTENT COAL EXTRACTION TECHNOLOGIES LEADS TO ITS POLLUTION WITH ROCK UP TO **38-40%**

If to conditionally divide gain between the mines of Western Donbass area, **7** out of them extract coal and **3** – rock

DECREASE OF COAL ENERGY CONTENT

ASH CONTENT INCREASE BY **1%**
LEADS TO COAL CALORIFIC VALUE
DECREASE BY **80** KCAL/KG

COAL CALORIFIC VALUE WITH
ASH CONTENT BEING 25%

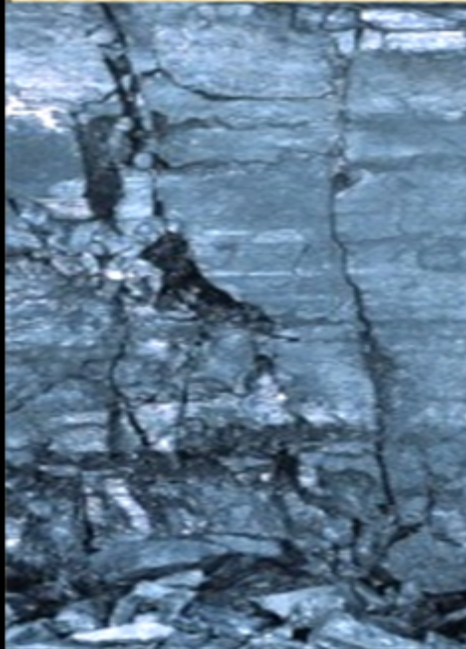
KCAL/KG

5200

4000

1200

LOSSES 40%

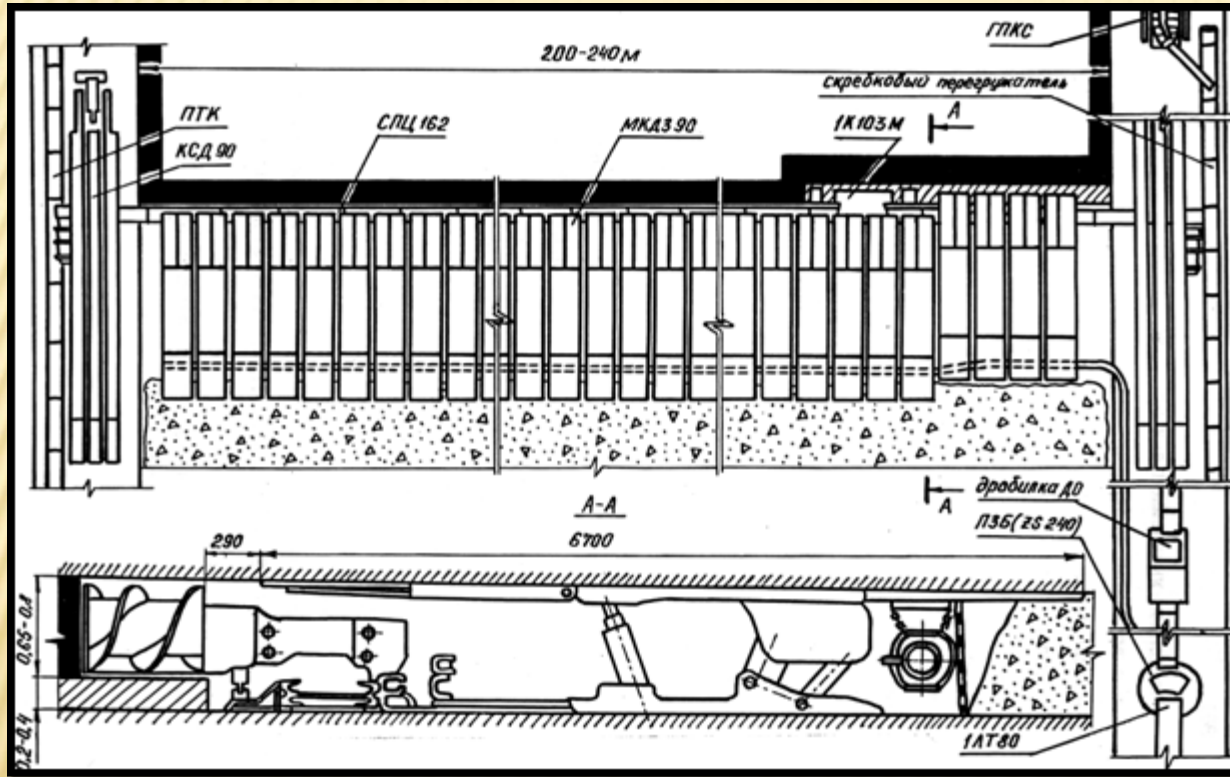


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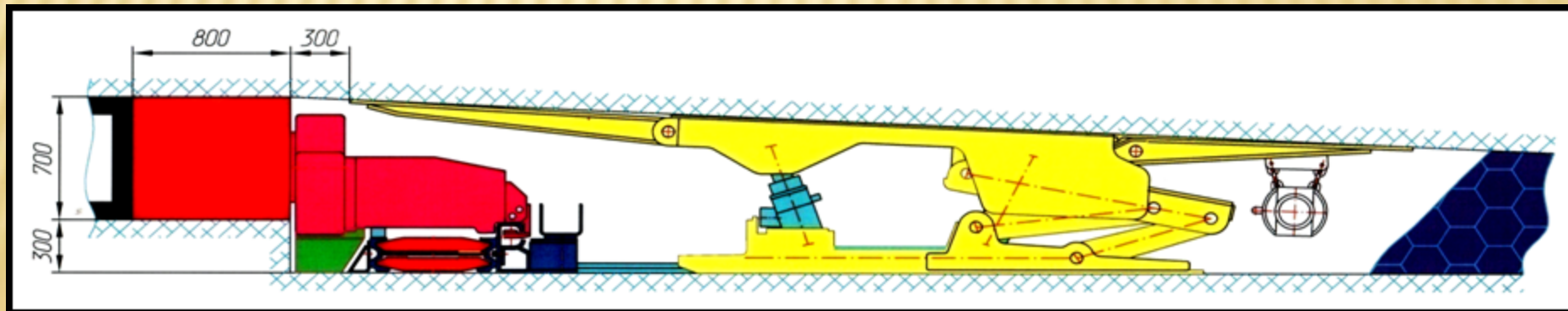


1. **Analysis of industrial reserves structure**
2. Selective technology
3. Advantages of the proposed technology
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SELECTIVE TECHNOLOGY CONCEPT

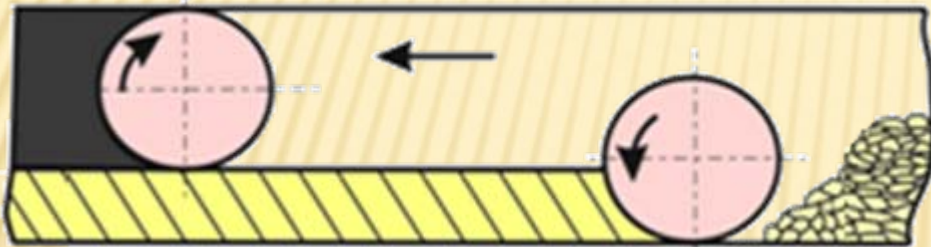


Coal and rock extraction is conducted separately during two cuts of a shearer. Extracted rock is simultaneously used as backfill for goaf.



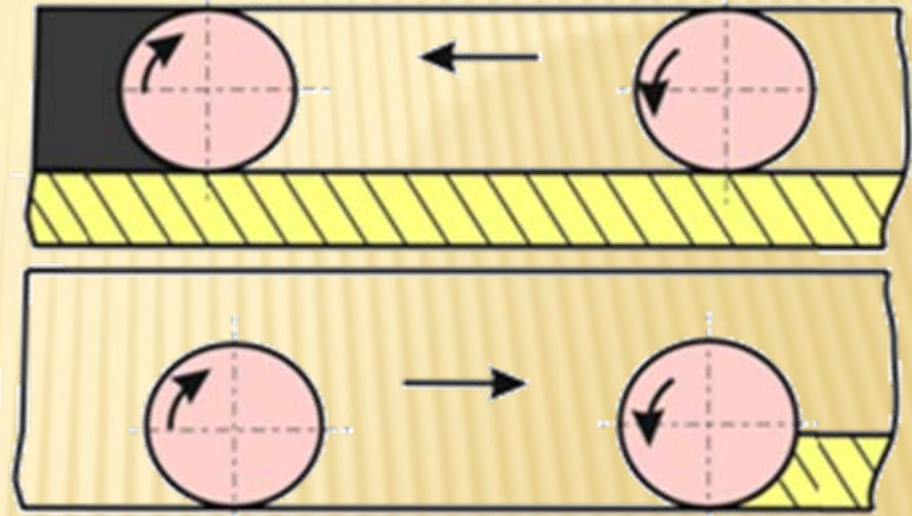
VARIATIONS OF COAL EXTRACTION TECHNOLOGIES

Bulk technology



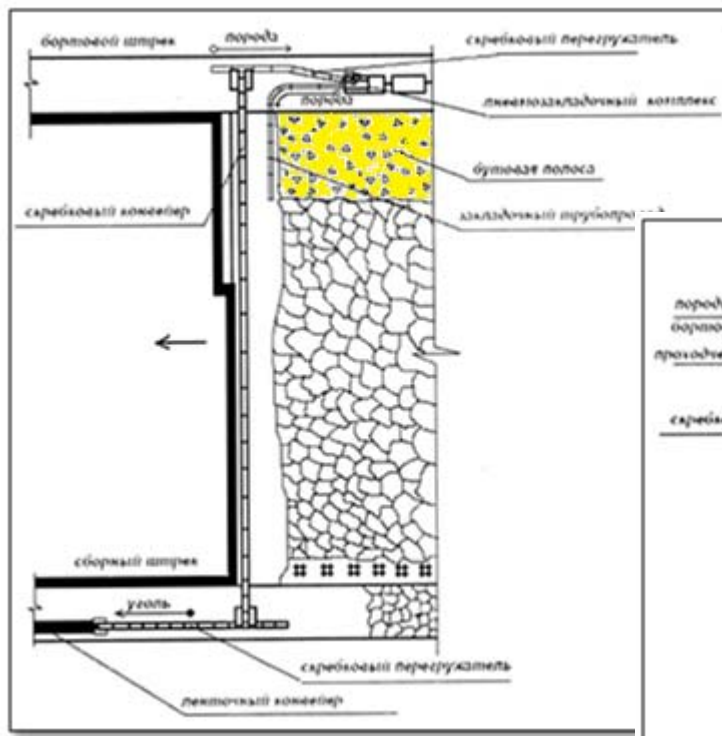
- Coal and rock extraction is conducted simultaneously during one cut of a shearer

Selective technology

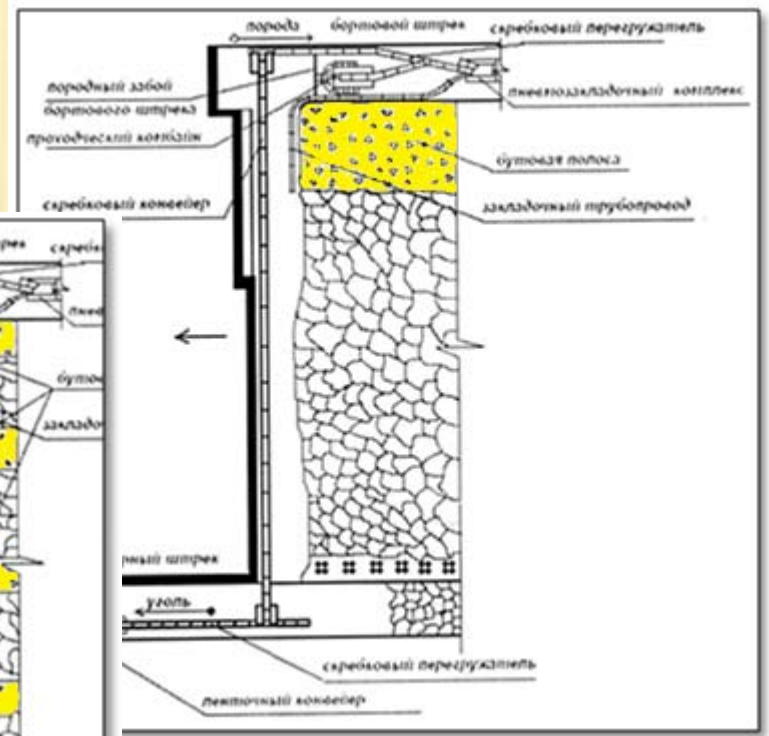


- Coal and rock extraction is implemented separately during two cuts of a shearer
- First direction of a shearer movement – coal extracted, reverse direction – rock extraction

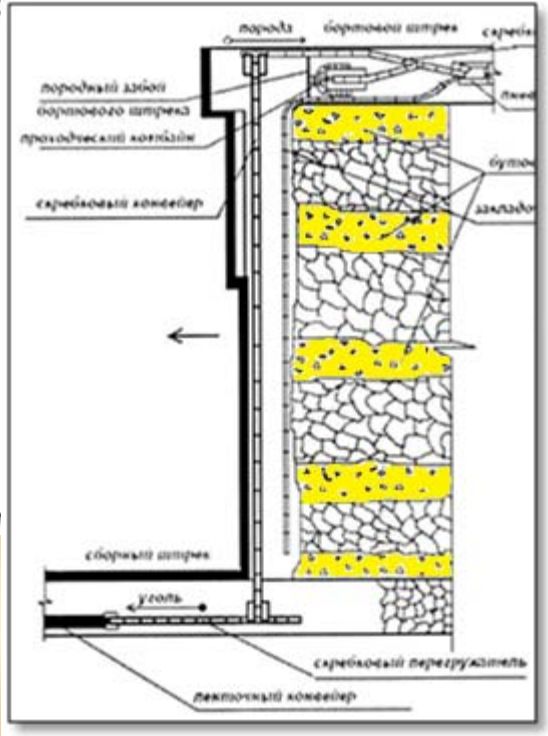
SELECTIVE TECHNOLOGY WITH UNDERCUT ROCKS BACKFILL INTO THE GOAF



LONGWALL MINING METHOD



COMBINED MINING METHOD

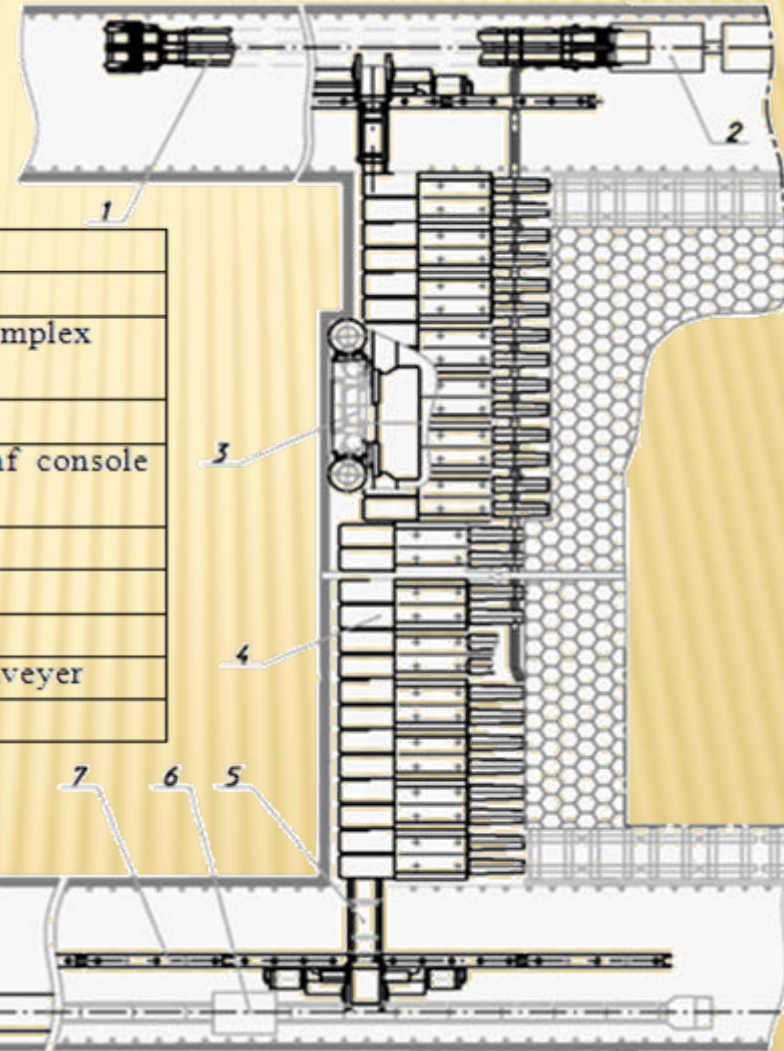


COMBINED MINING METHOD WITH UNIFORM LAYOUT OF GOB PACKS ALONG THE LONGWALL

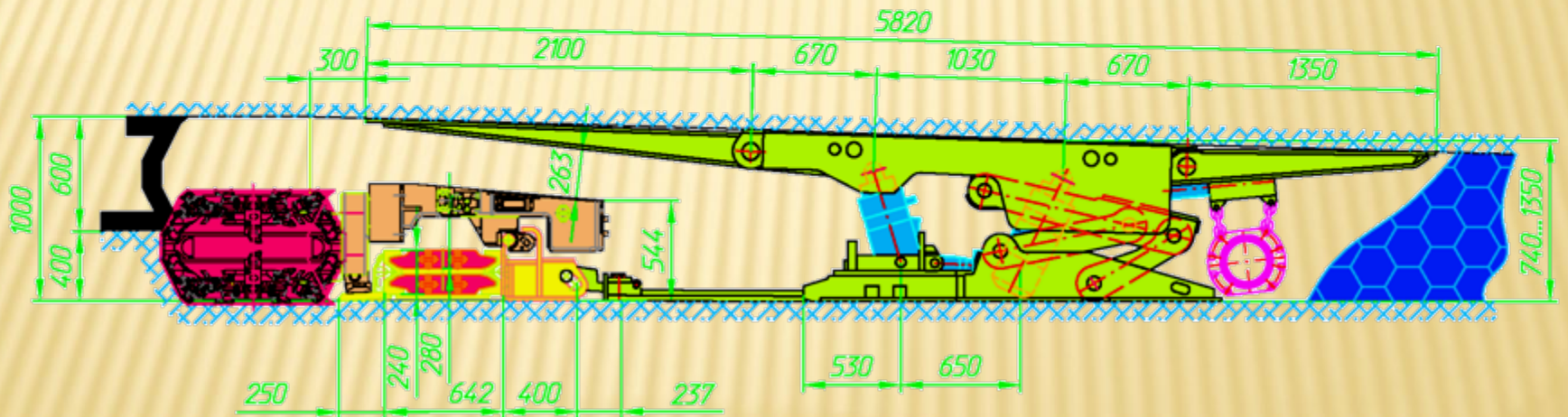
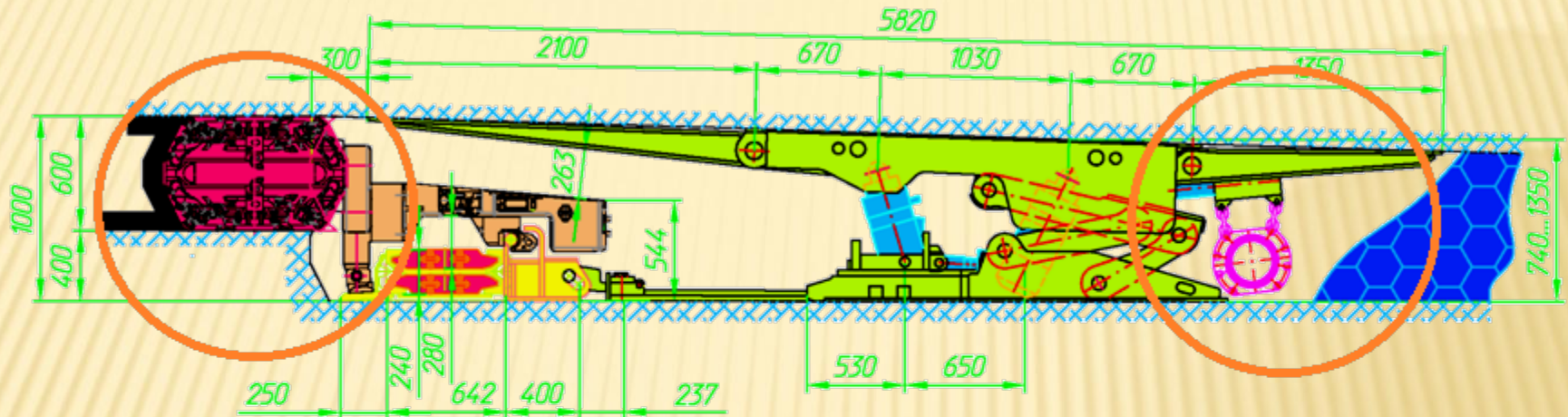
SELECTIVE TECHNOLOGY

COMPLEX FOR SELECTIVE TECHNOLOGY

Pos.	Notation	Title
1	BCC	Bin-collecting conveyor
2	"Titan M"	Mobile pneumatic stowing complex
3	SEC	Selective extraction shearer
4	1KD90TP	Four-frame section with goaf console (with 1.5 m installation step)
5	SPC26	Mine scraper conveyor
6	SP26USh	Mine loader
7	UCS	Abutment support
8	1LT800	Mine belt-type telescopic conveyor
9	1L800	Mine belt-type conveyor



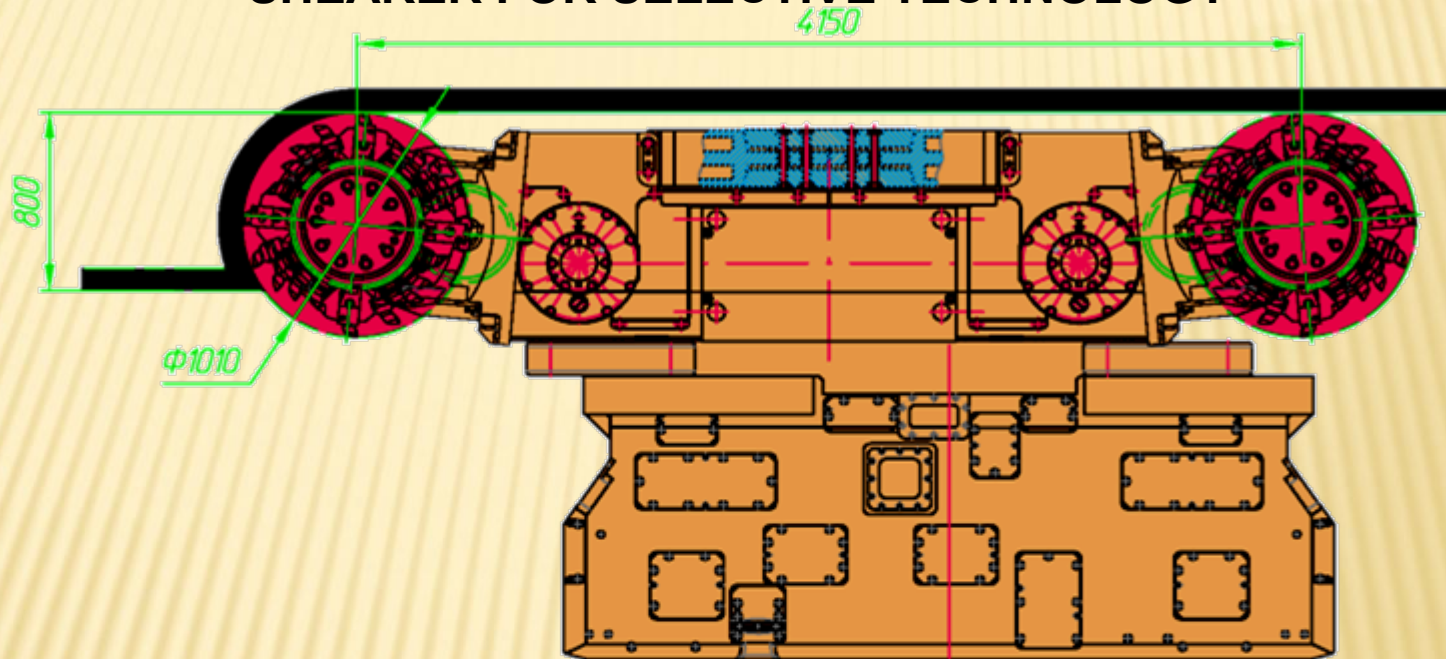
NEW MINING TECHNIQUE



○ - New technical solutions

SELECTIVE TECHNOLOGY ESSENCE

SHEARER FOR SELECTIVE TECHNOLOGY

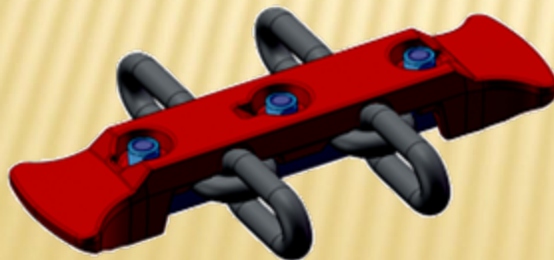
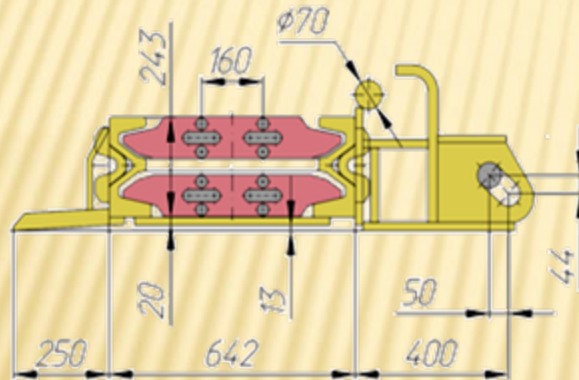
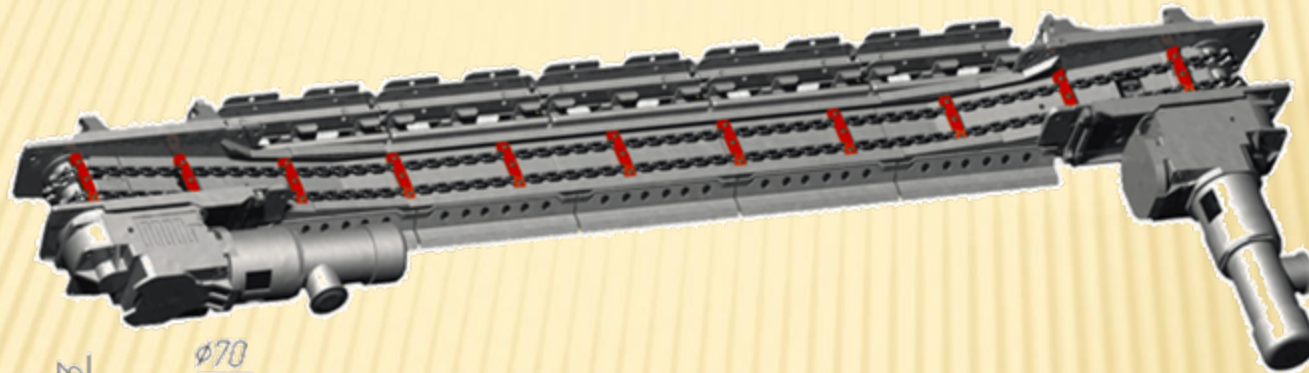


Short technical characteristics

Productivity, t/min	3.0-5.0
Applicability according to coal seam thickness, v	0.6-1.2
Total rated power, kW	310
incl. cutting tools drive	200
Rated voltage, V	660, 1140
Cutting width, mm	800
Maximal advance rate, m/min	10
Pulling force at maximal working speed, kN	300
Body height, mm	544
Shearer weight, t	15

SELECTIVE TECHNOLOGY ESSENCE

SCRAPER (FACE) REVERSE CONVEYOR

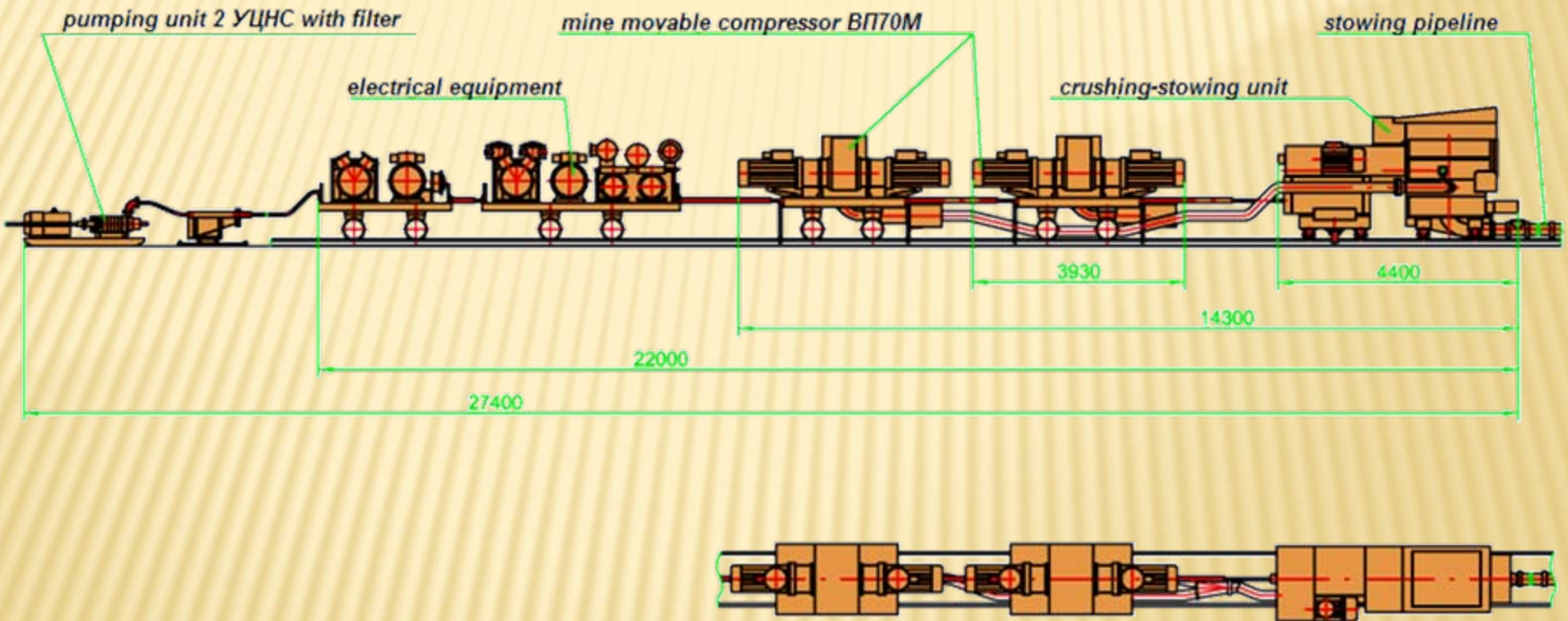


Technical characteristics

Maximal productivity, t/min	10
Face conveyor length, m	up to 350
Number and location of drive blocks, kW	2x65/200
Drive body movement speed, m/sec	
- working	1.1
- maneuvering	0.37
Number and location of haulage chains, pieces	2, central
Chain type (caliber, step, strength class)	30x108-C(D)
Pan height, mm	243
Pan width, mm	642
Pan length, mm	1500
Operation life (when transporting coal), mln. t.	2

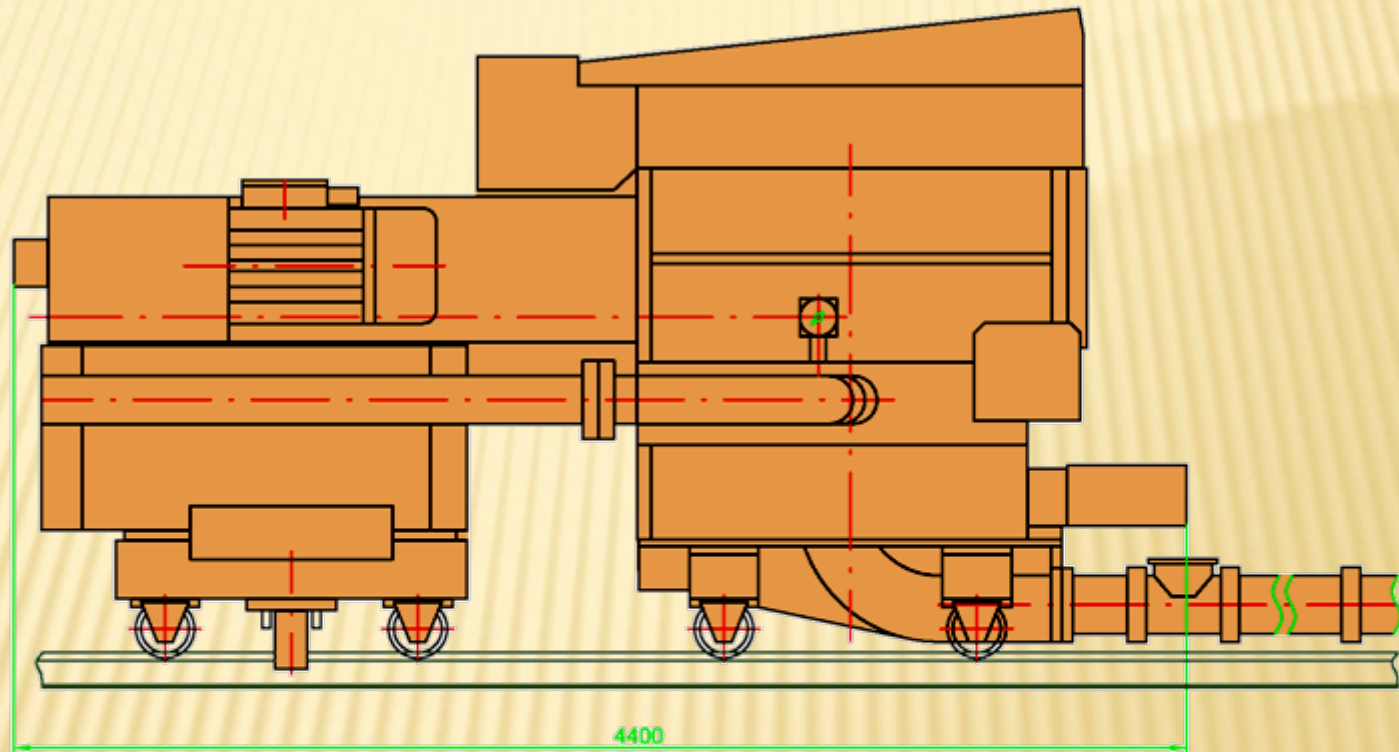
SELECTIVE TECHNOLOGY ESSENCE

PNEUMATIC STOWING COMPLEX "TITAN 1M"



SELECTIVE TECHNOLOGY ESSENCE

CRUSHING-STOWING EQUIPMENT

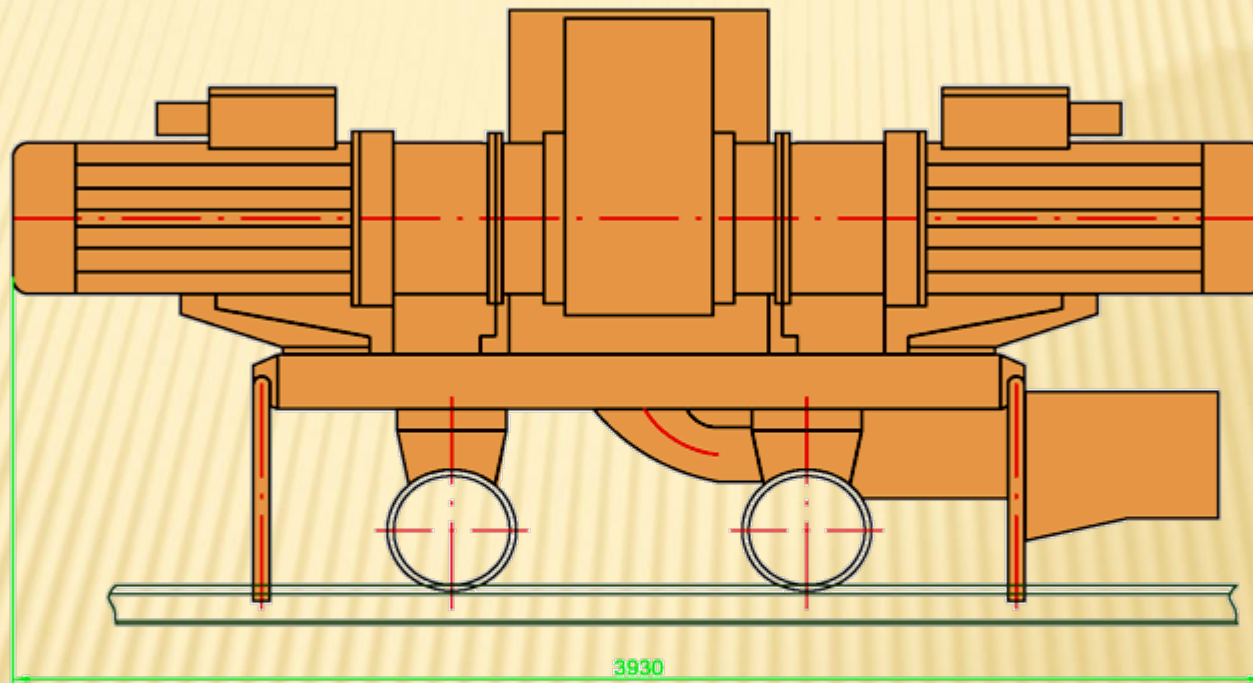


Short technical characteristics

Productivity, m ³ /h	20-80
Pipeline diameter, mm	195
Maximal acceptable size of stowing material pieces, mm	80
Drive power, kW	55
Weight of crushing-stowing unit, t	19.5

SELECTIVE TECHNOLOGY ESSENCE

COMPRESSOR BII70M



Short technical characteristics

<i>Short technical characteristics, m³/h</i>	3350
<i>Compressed air initial pressure, MPa</i>	0.100
<i>Final compressed air pressure, MPa</i>	0.225
<i>Drive power, Kw</i>	220
<i>Compressor weight, t</i>	6.4

SELECTIVE TECHNOLOGY IMPLEMENTATION EXPERIENCE

Selective technology implementation experience on “Blagodatnaya” mine (Ukraine) has shown coal with **ash content 15% can be technologically used.**

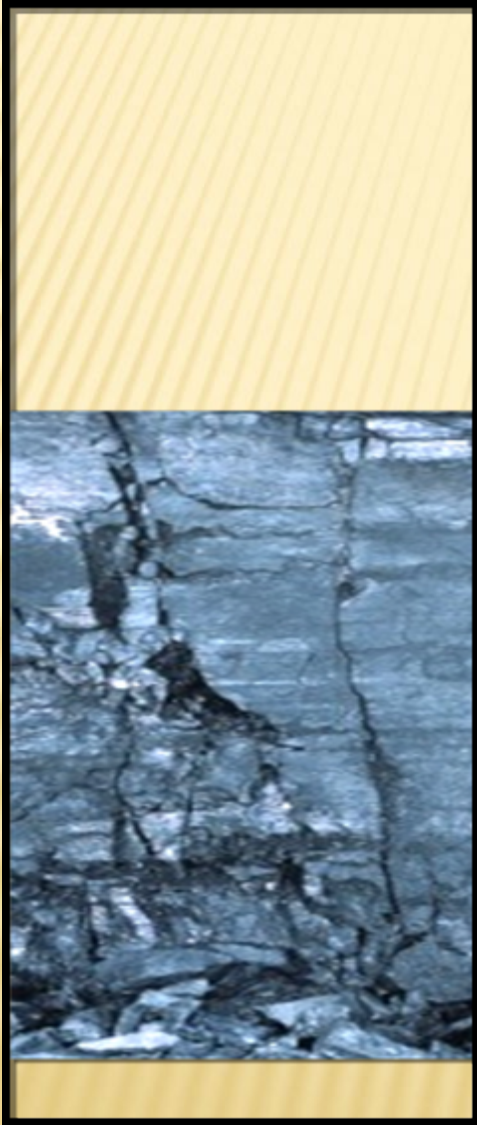
Complex KM-88 and shearer 1K-101Y have been used. Extraction pillar with length 700 m has been developed, longwall length – 160 m.

SELECTIVE TECHNOLOGY MISSION



- ❖ To lower prime cost of an end product – extracted coal by **10-15%**
- ❖ To additionally extract **341** mln. t. of coal with ash content **15-18%** with high efficiency from Western Donbass deposits.

ADVANTAGE OF THE TECHNOLOGY (ASH CONTENT)



Coal sent to the customer will have ash content not higher than **15%** – so, this is quality increase compared to enrichment (25%), by 10%.

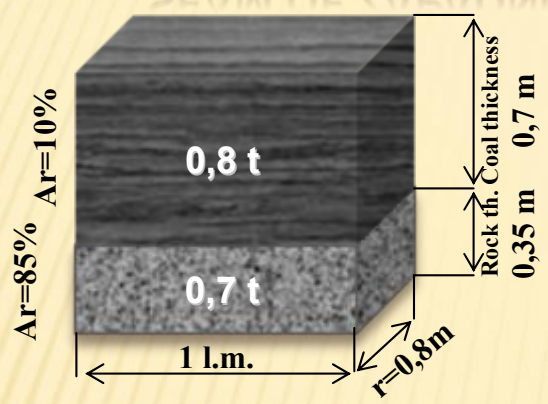
10% – additionally up to **800** kcal/kg

In this case calorific value will increase to **6000** kcal/kg

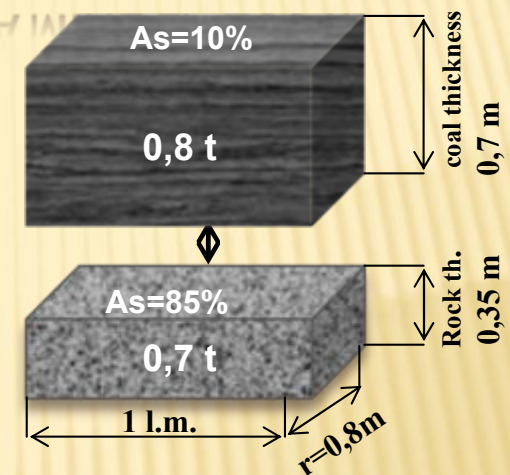
***NEW PHILOSOPHY OF
COAL EXTRACTION!!!***

SEAM OF ZAPADNO-DONBASSKAYA MINE LI=250 m

Bulk extraction



Separate extraction

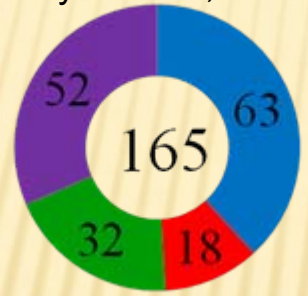


Shearer movement speed

$$V_e$$

4 m/min

Cycle time, min

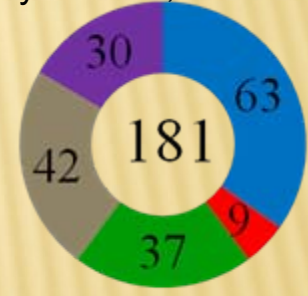


Shearer movement speed

$$V_{ey} = 4 \text{ m/min}$$

$$V_{en} = 6 \text{ m/min}$$

Cycle time, min



Daily output

2161 t
A=42%

713 t
Enrichment tailings

1426 t
A=30%
Concentrate

Quantity of produced energy, GWh



Quantity of produced energy, GWh



Daily output

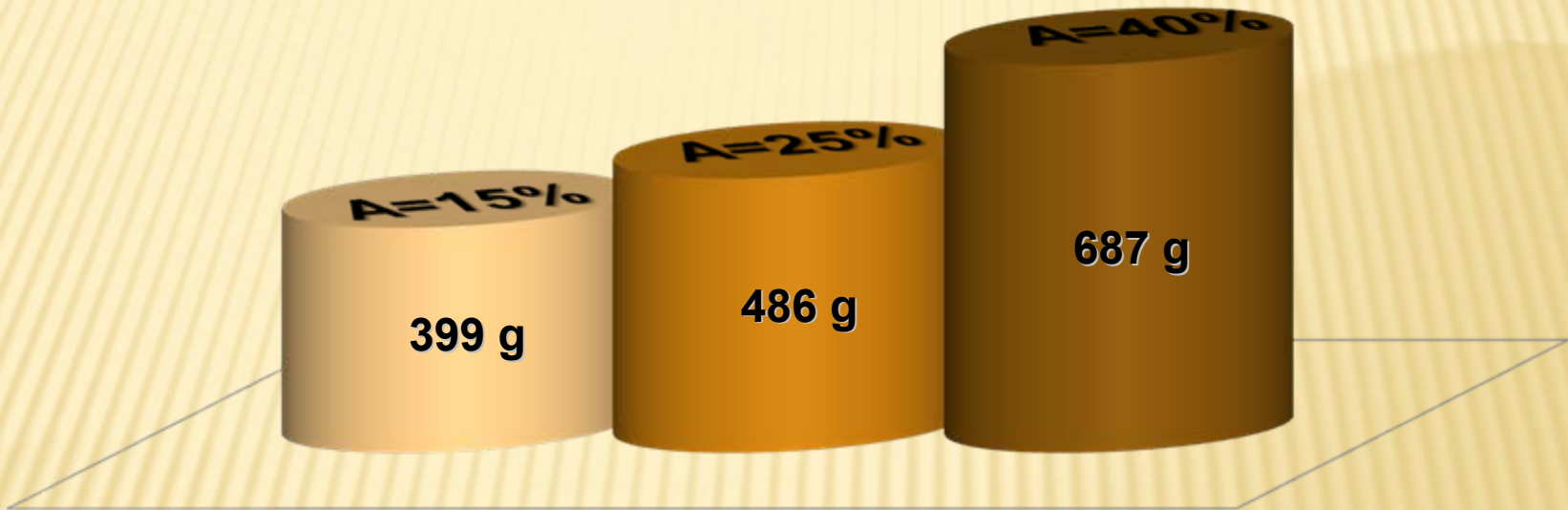
1074t
A=15%

Rock output (for backfill), t

812

- Explanation to the cycle time:
- Coal extraction time
 - Time of end operations
 - Downtime duration (conveyor lines failures)
 - Time for extraction and rock backfill into the goaf
 - Time of technological time breaks

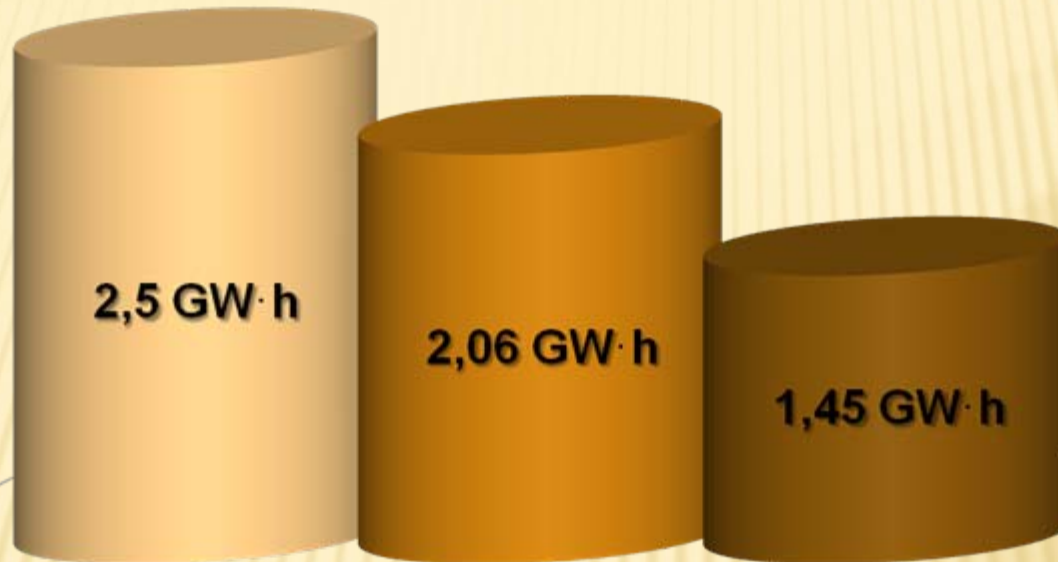
QUANTITY OF COAL NEEDED FOR GENERATION OF 1kW·h ELECTRIC ENERGY



To generate 1 kW·h of electric energy various coal quantity of various quality is needed.

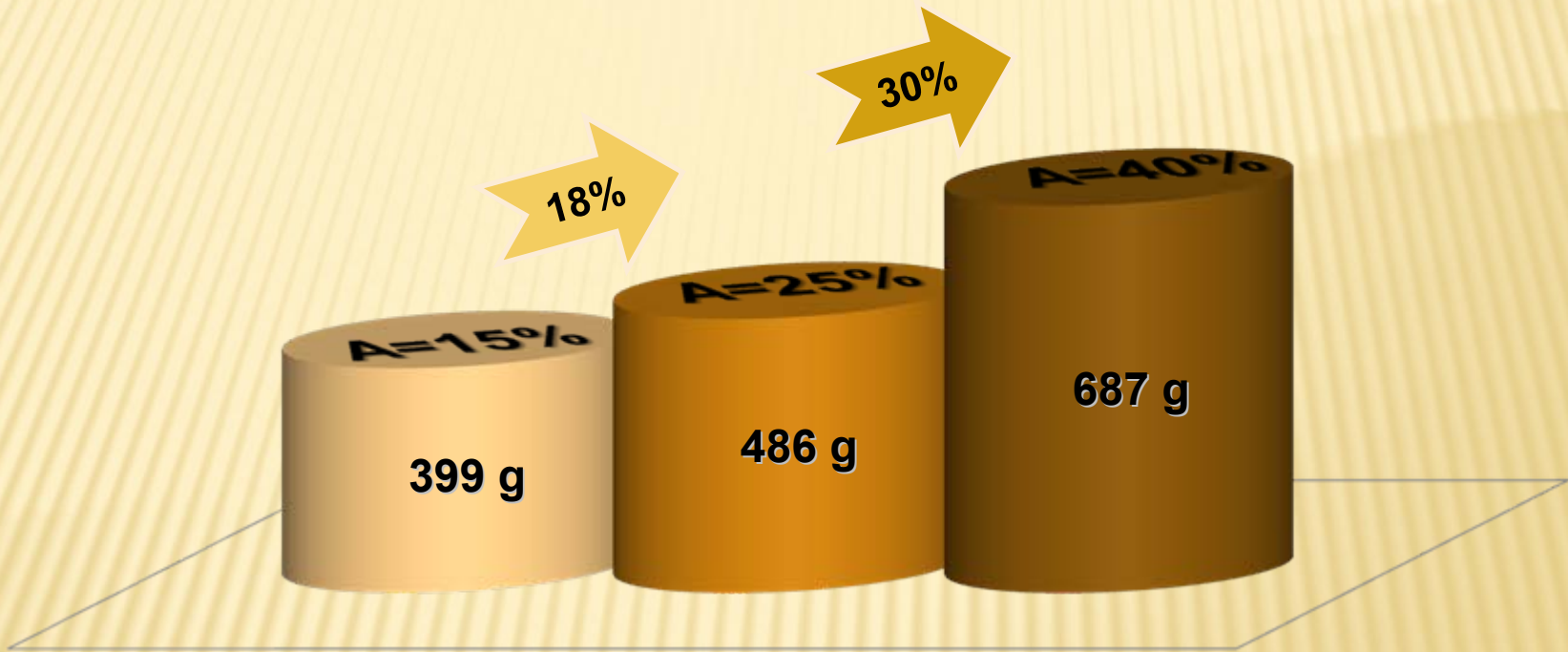
So, generate 1 kW·h - 399 g of coal with ash content 15% is needed; 486g with ash content 25% and 687g with ash content 40%.

ENERGY VALUE OF COAL AT ITS VARIOUS ASH CONTENT



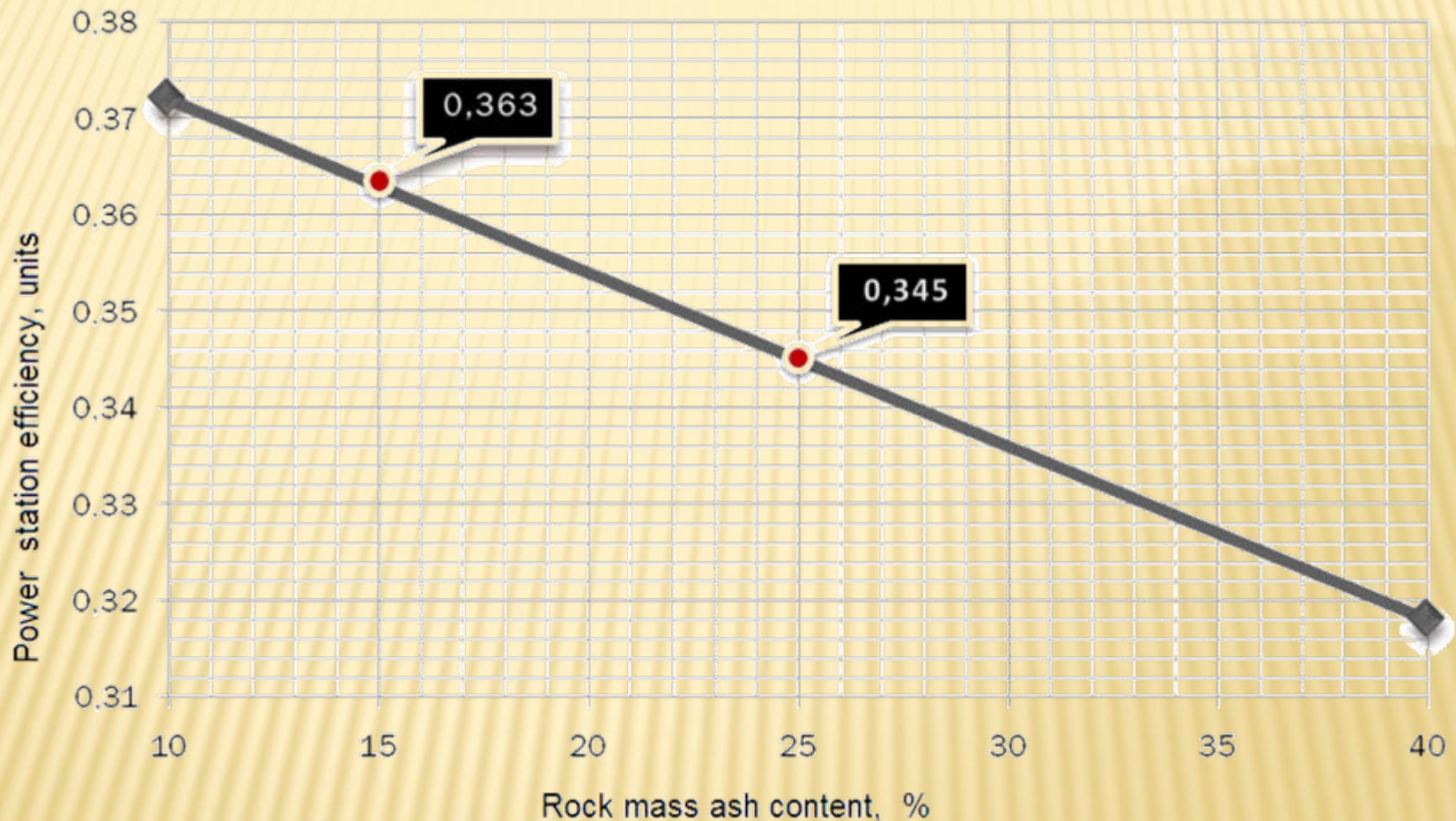
- Selective technology will allow to extract coal with ash content equal to 15%, and burning of 1t of coal will allow to receive **2,5 GW·h** electric energy;
- During bulk extraction of 1t of coal enriched to 25% **2,06 GW·h** of electrical energy will be produced;
- 1t of raw coal with ash content equal to 40% will allow to produce **1,45 GW·h** of electric energy.

DEPENDENCE OF HARMFUL MATTERS EMISSION ON QUALITY AND QUANTITY OF BURNT COAL



Quality of harmful matters released into the atmosphere proportionally increases with burnt coal volume increase.

ROCK MASS ASH CONTENT INFLUENCE ON POWER STATION EFFICIENCY



Selective technology implementation will allow to increase power station efficiency by **1,5-2%** that is equal to savings of about **2,7 mln. \$ US** a year.

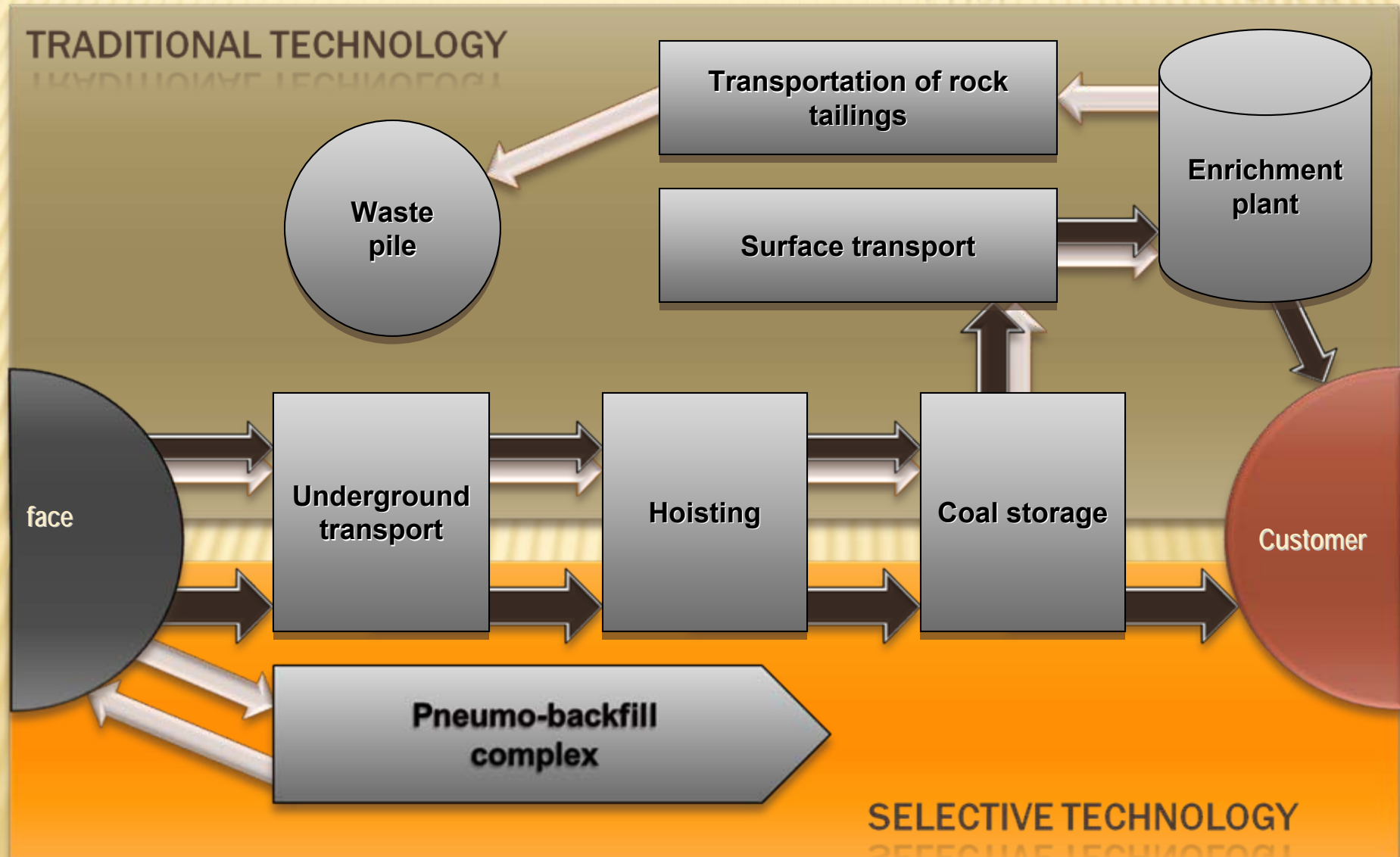
CONTENT



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COMPARATIVE SCHEME OF COAL AND ROCK TRANSPORTATION

➡ COAL ➡ ROCK



COAL PRIME COST REDUCTION DURING SELECTIVE TECHNOLOGY COMPARED TO BULK (M. «ZAPADNO-DONBASSKAYA»)

COST PARAMETERS	DIRECTION OF SHIPPING	%	INFORMATION SOURCE
	ENRICHMENT PLANT		
FULL PRIME COST IN MINE	351,3 UAH/t	100	CALCULATIONS BASED ON MINE
minus expenses:			CALCULATIONS BASED ON MINE DATA
CONVEYOR TRANSPORT	—2,52 UAH/t	0,7	
LOCOMOTIVE TRANSPORT	—6,63 UAH/t	1,7	
HOISTING ON SURFACE	—2,21 UAH/t	0,6	
SURFACE TRANSPORT	—66,7 UAH/t	19	
ENRICHMENT	—35,3 UAH/t	10	
REPEAT USE OF DEVELOPMENT WORKINGS	—4,0 UAH/t	1	
PRIME COST REDUCTION	—117,3 UAH/t	33	
EXPENSES ON BACKFILL COMPLEX +17%	+36,3 UAH/t	17	From world experience of stowing practice and CJSC «ZZhRK» (Ukraine), share of stowing works in total prime cost makes up 16-17%.
TOTAL REDUCTION OF PRIME COST	93 UAH/t	16	

DECREASE OF COAL PRIME COST DURING SELECTIVE TECHNOLOGY COMPARED TO BULK TECHNOLOGY (M. «SAMARSKAYA»)

COST PARAMETERS	DIRECTION OF SHIPPING	%	INFORMATION SOURCE
	ENRICHMENT PLANT		
TOTAL PRIME COST IN MINE	126,96грн/т	100	CALCULATIONS BASED ON MINE
minus expenses:			CALCULATIONS BASED ON MINE
CONVEYOR	—1,74 грн/т	1,4	
TRANSPORT	—1,26 грн/т	1	
HOISTING ON THE SURFACE	—12,05 грн/т	9,6	
SURFACE TRANSPORT	— 8,28	6,5	
DRESSING	грн/т	3,8	
LAND RECOVERY	—4,87 грн/т	3,7	
REPEATUSE OF DEVELOPMENT WORKINGS	—4,72 грн/т		
PRIME COST REDUCTION	—32,92 грн/т	26	From world experience of stowing practice and CJSC «ZZhRK» (Ukraine), share of stowing works in total prime cost makes up 16-17%.
EXPENSES ON BACKFILL COMPLEX	+21,58 грн/т	17	

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CONCLUSIONS

Selective technology will allow to :

- additionally extract more than 500 mln. t. of coal from active mines of Western Donbass area;
- lower coal extraction prime cost by 10...15% compared to the existing technology;
- extract coal with ash content not higher than 15...18%;
- leave dozens of millions of tons of rock in goaf;
- provide and exceed gained level of electric energy production;
- lower harmful matters emissions into the atmosphere during coal burn;
- increase rate of stoping preparation, provide significant economy during drivage and maintenance of mine workings due to their repeat usage;
- liquidate considerable land surface deformations caused by mining operations conduction;
- not to allocate additional land areas on surface for rock dumps and tailings.

**THANK YOU
FOR YOUR
ATTENTION**