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IN-PIT CRUSHING AND CONVEYING TECHNOLOGY ADVANCEMENT FOR LOW-GRADE, HIGH-PERFORMANCE DEPOSITS AND CONVEYING SYSTEMS

Abstract. In-Pit Crushing and Conveying systems are well known and are described by their financial efficiency, reduced fuel consumption operating costs, transportation costs, and pollution compared to traditional dump truck frameworks. Fully portable frame for carrying and draining water in pits, including tractor, two universal installations: atomization and drainage installation. The innovations envisaged for priming uncoated raw peat enjoy the accompanying benefits: reduction in truck fleets; reduction of transportation costs; the ability to work hard with peat; reduction breaker energy consumption; eliminates the need to install water treatment equipment on the production line as the crushed water returns to the pit.

Key words: *cyclo-flow technology, low-grade deposits, technology improvement, component, crushing, peat, machine convey systems, in-pit crushing.*

Төмен сортты, өнімділігі жоғары кен орындары мен көлік жүйелері арналған карьерде ұсақтау және тасымалдау технологиясын жетілдіру

Андатпа. Карьерде ұсақтау және тасымалдау жүйелері белгілі және дәстүрлі самосвал жүйелерімен салыстырғанда олардың қаржылық тиімділігімен, отын шығынының төмендеуімен, пайдалану шығындарымен, көлік шығындарымен және ластануымен сипатталады. Тракторды қоса алғанда, шұңқырлардағы суды тасымалдауға және ағызуға арналған толық портативті жақтау, екі әмбебап қондырғы: бүріккіш және дренаж. Жабылмаған шикі шымтезекті төсеу үшін қарастырылған инновациялардың келесі артықшылықтары бар: жүк көліктері паркін қысқарту; көлік шығындарын азайту; шымтезекпен қарқынды жұмыс істеу мүмкіндігі; энергияны тұтынуды азайту; өндірістік желіде суды тазартатын жабдықты орнату қажеттілігін жояды, өйткені ұсақталған су карьерге қайта оралады.

Түйінді сөздер: *цикло-ағынды технология, төмен сортты кен орындары, технологияны жетілдіру, компонент, ұсақтау, шымтезек, машиналық-конвейерлік жүйелер, карьерлік ұсақтау.*

Усовершенствование технологии дробления и транспортировки в карьере для низкосортных, высокопроизводительных месторождений и транспортных систем

Аннотация. Системы дробления и транспортировки в карьере хорошо известны и характеризуются их финансовой эффективностью, сниженным расходом топлива, эксплуатационными расходами, транспортными расходами и загрязнением окружающей среды по сравнению с традиционными системами самосвалов. Полностью переносная рама для переноски и слива воды в ямах, включая трактор, две универсальные установки: распылительную и дренажную. Инновации, предусмотренные для грунтования непокрытого торфа-сырца, имеют сопутствующие преимущества: сокращение парка грузовых автомобилей; снижение транспортных расходов; возможность интенсивной работы с торфом; снижение энергопотребления; устраняет необходимость установки оборудования для очистки воды на производственной линии, поскольку обработанная вода возвращается в карьер.

Ключевые слова: *цикло-поточная технология, низкосортные залежи, совершенствование технологии, компонент, дробление, торф, машинно-конвейерные системы, карьерное дробление.*

Introduction

In-pit Crushing and Conveying Systems (IPCC) outperform standard dump truck frames monetarily. These systems save operating costs, transportation costs, fuel consumption, and pollution. Creating a deep hole with a single level of seats is the most common technique for removing peat bogs. In open pit mining, choosing the right tractor and loader fleet is a complex task. To address this challenge, it is necessary to choose a fleet of tractors and loaders and organize a production schedule that reduces the amount of money spent on transportation and other fixed costs [1]. Truck frames are often used in conjunction with standard mining equipment while extracting peat deposits. The output of the runtime is defined by the framework's separate stacking and dispatching units.

To reduce peat deposits at the lowest cost, deep excavation is the preferred method. Tractor and loader types utilized in an open pit are determined by the kind of material being separated, as well as environmental conditions like seat height. Farm trucks and semi-trailers are often used to transport raw peat from open pit mining to a fixed treatment plant. Transport costs are a major factor in both the initial investment and ongoing running costs of large-scale peat mining. In certain businesses, the cost of diesel fuel for corporate automobiles might amount to 15%-35% of total operating expenditures[1].

More vehicles are needed to move goods across longer distances. You can go about town with the semi-trailer just fine. Equipment including crushers, mixers, separators, and dewatering devices are set up in the peat treatment facility. So, the cost of commodities like fuel, tires, and clothes per tonne of raw peat goes up. The acronym IPCC (which stands for «In-pit Crushing and Conveying System») is common parlance in the mining industry [2]. IPCC and truck frames are preferred over traditional mining tool truck frames because of its low cost and high quality reliability in today's mines. Completely mobile crushing, conveying, and dewatering equipment being investigated for their potential role in the expansion of open peat mines.

Literature Review

According to [3] In-Pit Crushing and Conveying (IPCC) systems are becoming more popular because to the

[1]Carter R.A. Taking a Closer Look at IPCC. IN-PIT CRUSHING [electronic resource]. – 2022. https://www.e-mj.com/features/taking-a-closer-look-at-ipcc/

current and predicted characteristics of open-pit mining operations. Now more than ever, it is crucial to find ways to lower the cost of truck haulage, which accounts for almost half of a mine's operating costs. Savings on transportation fees may be substantial if crushing operations could be moved closer to the mine sites. The research provides a comprehensive literature review of all aspects of the technical, economic, and sustainable evolution of in-pit crushing systems, in addition to a statistical analysis of the systems from 1956 to the present. Furthermore, the paper covered the breadth of future research, design, and planning issues, as well as the constraints of using the IPCC approach. Some of the most pressing questions that have yet to be answered are the IPCC's strategy for waste materials, the optimal conveyor exit scheme, the ultimate pit limit for completely mobile systems, and the transition time from a pure-truck system to an alternate IPCC system.

Open Peat Mining

Peat is a naturally occurring soil that is finicky, soft, and water-retentive. By definition of the Unified Soil Characterization Framework, peat is a natural soil (USCS). Particles of grass, leaves, twigs, and other perennials are common among these contaminants. Peat evacuation is the most common method of peat extraction. When harvesting peat, it's necessary to dredge vertically and almost to the bottom. Today's standard operating process for peat extraction from open pits includes the following steps:

Extraction-transport- relocation- and storage. It's possible that dredgers on the sea may easily extract the peat that's used as a raw material. To allow for critical depth exposure, material must be kept stable and maintained. Common applications of overburden and stacking clock systems are in open pit mines [4]. Semi-trailers are often utilized to transport mined peat oil to storage facilities in the conventional configuration. The most common challenges with peat extraction are diminished peat deposits, restricted peat carrying capacity, weak peat deposit strength during excavation, and high groundwater levels. It's possible that the ease with which the manure may be moved is the single most crucial consideration to make while removing peat. Peat is a delicate soil layer that regulates the soil's bearing and shifting capacities [5]. The most practical and efficient aspect of open peat mining is the hauling away of mined waste and unprocessed peat. There is an argument in favor of taking into account the IPCC framework's peat harvesting procedures.

The completely versatile scaffold in open pit mining consists of a tractor and two mobile components (a tamping unit and a dewatering unit). The tractor does not get in the way of the semi-trailer since it stays put in the peat shop, where it feeds raw peat into a mobile crusher bin. The fundamental features of tugboats are their high deformability and poor peat stock carrying capacity. Earthworms and generalists alike leave their skeletons behind to facilitate migration. Most stacking positions depend on the general situation of the lawn tractor, the universal crusher, and most emptying positions to achieve the desired result of having the crates curve and pass through the container.

Mobile Crushing Plant

The bulk of the peat deposit is typically obtained during the stump removal process. Gather the wood you placed next to the peat while making it. Almost little accumulation of wood residue can be seen. Wood is at best sorted, cut, and consumed in the engine compartment, but the total amount used is far less than the total amount removed

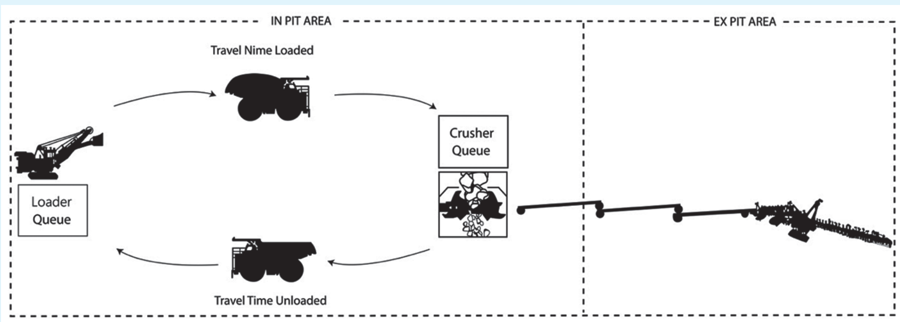

Figure 1. Material flow in an in-pit.
Сурет 1. Шұңқырдағы материал ағыны.
Рис. 1. Поток материала в карьере.

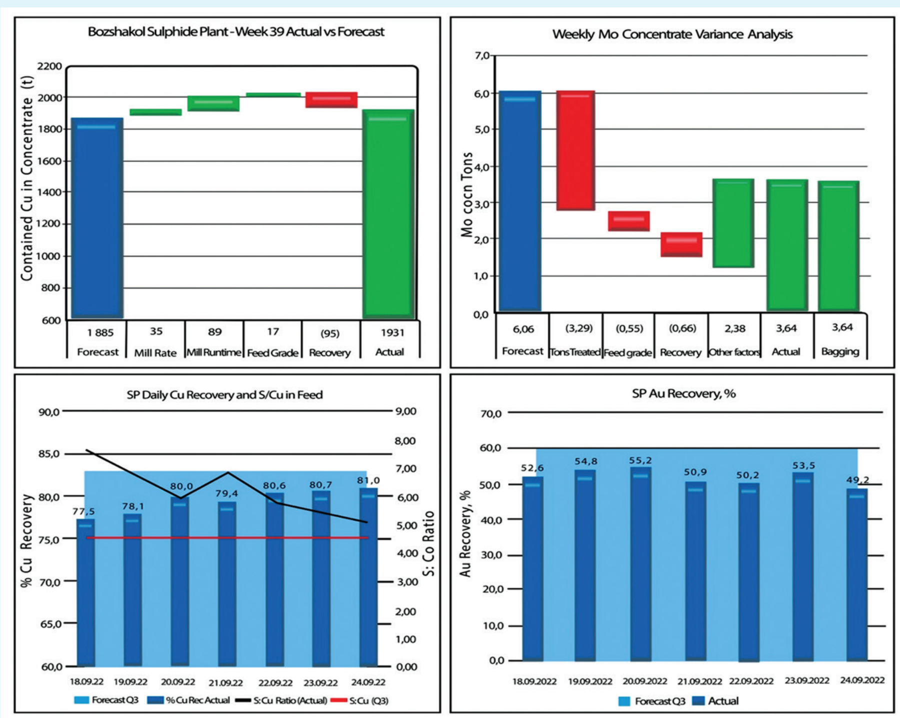

Figure 2. Suggested cleaning actions.
Сурет 2. Ұсынылатын тазалау әрекеттері.
Рис. 2. Предлагаемые действия по очистке.

from storage. Accumulation of the driest wood remnants is another element that raises the risk of fire in peatlands and the surrounding areas. One of the biggest challenges confronting the peat industry is the complicated development of ecologically suitable technologies in the production and processing of all-natural materials in peat storage.

Crushing raw peat is an essential part of the peat extraction process, since this is where the peat is destroyed in a controlled manner. This is the main feedback loop in the readiness interaction, which may be optimized further to reduce overall system size. Universal lubricants separate out from the crowd because they combine damaging peat mixing with wood separation consideration in a single mechanical device.

The isolation method consists mostly of two steps: screening for and removing large wood particles during raw peat extraction, and screening for and removing small wood particles during natural peat processing. At each step of the test's excavation and crushing processes, the wood is removed to reduce the amount of energy used in preparation for the subsequent peat phase. Peat, which is easily damaged and highly degraded, must be organized as part of the processing process. The peat fiber structure acts as a filter during drainage. The roller crusher, when employed alone, may be put to work on a small scale to crush both coarse and fine materials. A cutting blade on this plant makes it much easier to work with peat moss, which can be rather sticky when wet.

It takes less force to cut with modern blades. The processing roller is like a flywheel in that it helps regulate power and ensures everything runs smoothly. The mechanism for switching out only one roll is convenient, trustworthy, and simple to develop. This is how you should put raw peat into the planter. thick layers of peat moss. The peat is sent to the subsequent mill for additional processing after treatment. When scraps of wood are chopped off and thrown away, the cutting components crush the natural elements they come into contact with[2].

The wet ore processing flowsheet

The flowchart illustrates crucial improvements for a common setup. Normal distribution, piling, and grinding procedures are followed for the cleansed and smashed metal, while the principal garbage is separated out [6]. Much important work on environmental destruction and enhanced metallurgy at lower reagent costs may result from this training. Hazardous actions may usually be reduced to a manageable handful every day.

Suggest cleaning action

The worn surfaces and rollers of the roof panels should be designed in such a way that they may sit softly on the damp bottom sediment without requiring excessive support. A good defense is to get the biggest feeder you can afford right now, even if it's more expensive overall.

The mineral feeder then disregards the vibrating coils/grizzly. For a company producing between 150 and 200 tons per day, this may be a gap of about 2 inches [6]. As a result, the bear is able to move about on wet, sticky surfaces. High-pressure water sprays are commonly used to help set fractures caused by the grizzly bear's jaw.

The particles are either conveyed to the washer and drum mix from the Grizzly and Breaker releases, or they are gravity fed to the mix. Here, after further scrubbing and washing, the metal is split in two, usually along the edges and by less than an inch. After fragments are cleansed, they are crushed again by other punch cones. The choice between open and closed circuit for auxiliary crushing depends on the metal's real composition and the desired degree of crushing [7].

Source: [8]

Capacity Determination Methods

When comparing the structure, definition, accessibility requirements, and use constraints of different time use patterns, there are many similarities. Time, for instance, is commonly broken down into many categories within the planning stage, such as used, available, and free. Inconsistencies in the terminology used to describe the condition, comfort, and technical specifications of equipment used in mining operations muddy estimates and specifications. TGL 32 - 778/01-15 may more easily dismantle the time component of the SMIPCC design after the time consumption model has

		WEEKLY		Variance	Variance	MONTH TO DATE		Variance	Variance
	Unit	ACTUAL	Q3 FORECAST		%	ACTUAL	Q3 FORECAST		%
Crushed ore		556 110	521 732	34 378	7%	1 932 815	1788 796	144 019	8%
Ore processed		556 031	521 732	34 299	7%	1 927 412	1 788 796	138 616	8%
Throughput	TPOH	3 310	3 252	57	2%	3 364	3 252	112	3%
Utilisation	%	100,0	95,5	4,5	5%	99,5	95,5	4,0	4%
Availability	%	100,0	96,5	3,5	4%	99,6	96,5	3,2	3%
Average grade									
Copper	%	0,44	0,43	0,00	1%	0,43	0,43	(0,01)	(1%)
Gold	g1	0,23	0,23	(0,00)	(0%)	0,23	0,23	0,00	2%
Molybdenum		0,0072	0,0054	0,002	33%	0,0070	0,0054	0,002	29%
Metal content in ore processed									
Copper	t	2 426	2 258	168	7%	8 229	7 742	487	6%
Gold	az	4 050	3 816	234	6%	14 391	13 084	1 307	10%
Molybdenum	t	40,0	28,2	11,8	42%	134,6	96,6	38,0	39%
Recovery rate									
Copper	%	79,6	83,5	(3,9)	(5%)	79,7	83,5	(3,8)	(5%)
Gold	%	52,3	59,6	(73)	(12%)	55,3	59,6	(4,3)	(7%)
Molybdenum	%	4,35	10,0	(5,6)	(56%)	1,9	10,0	(8,1)	(81%)
Cu concentrate produced	t	8 609	8 570	39	0%	30 169	29 384	785	3%
Cu in concentrate produced	t	1 931	1 885	46	2%	6 555	6 464	90	1%
% Cu in concentrate	%	22,4	22,0	0,4	2%	21,7	22,0	(0,3)	(1%)
Copper produced		1 844	1 801	44	2%	6 260	6 174	86	1%
Au in concentrate produced	az	2 118	2 275	(156)	(7%)	7 962	7 799	163	2%
Au in concentrate	g1	7,7	8,3	(0,6)	(7%)	8,2	8,3	(0,0)	(1%)
Gold produced	az	1 981	2 127	(146)	(7%)	7 444	7 292	152	2%
Mo concentrate produced	t	3,64	6,1	(2,4)	(40%)	5,48	20,8	(15,3)	(74%)
Mo in concentrate produced	t	1,74	2,8	(1,1)	(38%)	2,61	9,7	(7,0)	(73%)
% Mo in concentrate	%	47,9	46	1,4	3%	47,6	46	1,2	2%

Figure 3. Capacity determination methods.
Сурет 3. Сыйымдылықты анықтау әдістері.
Рис. 3. Методы определения пропускной способности.

[2]*Ritter R. Contribution to the capacity determination of semi-mobile in-pit crushing and conveying systems. – 2016 – 176 p.*

been validated [9]. Material handling frames that use consolidated material supports may benefit, in the opinion of the standard's creator, from starting with this guideline.

Their link is expected to shift over time since the TGL 32-778/01-15 is written for frame-related materials with stationary vehicles. A unique time-use model was created so that the estimating model could be used to predict the limits of the SMIPCC framework. Time span implying a generally positive mean position and a size that fluctuates randomly throughout time. The time model below displays the production units in tones and the actual ore vs the expected in a week [9].

Discussion

Duration between disruptive effects or cures of the scaffold elements should be dispersed over the operational time. This assumption is valid for working components of the building that don't sit inactive for long stretches of time [10].

However, an important part of the IPCC framework is the calculations used to investigate cases when vehicles and shippers need lengthy periods of human labor [10]. This is especially true for trucks carrying high loads and vehicles with heavy weights, such as those equipped with loaders and fixed IPCC frame parts. Since the work output is less than the compelling operating moment, the component working season is generally expected to be significantly delayed for circumstances where frame components are disrupted [11]. As a result, people have less time for themselves, which increases productive work hours and pushes back annual framework limits. The results of a good context analysis may be judged crucial when applied to the framework's components.

Conclusion

Since its inception 10 years ago, the SMIPCC framework for transporting waste rock materials has received extensive interest from the mining industry. As the IPCC framework grows in importance, so does the need for analytical research to examine its significance. The research was based on information about the framework's expected uptime and the annual capability to meet the distributed production goals. Deterministic calculations are generally accurate and efficiently carried out. Problems and operational differences like delays and imprisonment are unavoidable in any earthmoving, quarrying, or mining activity, no matter how well the process is managed or paid.

Thus, conventional computer techniques gradually faded away, and results fell short of expectations. Conventional computing methods have four major drawbacks: they fail to fully account for or accurately represent the IPCC framework's potential limitations; they cause concern when adjustments are needed to meet task-specific requirements; they necessitate standardizing conditions across the enterprise; and they effectively mediate the risk of human error. In addition, they fail to recognize or accurately portray the consequences of a framework's dysfunctional parts and their interconnections. This recommendation encourages a well-organized strategy for applying the annual constraints of the SMIPCC framework to the components of the disordered behavior framework and their relationships.

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