Unconventional oil resources exploitation: A review

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Unconventional crude oil sources are geographically extensive and include the tar sands of the Province of Alberta in Canada, the heavy oil belt of the Orinoco region of Venezuela and the oil shales of the United States, Brazil, India and Malagasy. High production costs and low oil prices have hitherto inhibited the inclusion of unconventional oil resources in the world oil resource figures. In the last decade, developing production technologies, coupled with the higher market value of oil, convert large quantities of unconventional oil into an effective resource. From the aspect of quantity and technological and economic recoverability are actually the most important tar sands. Tar sands can be recovered via surface mining or in-situ collection techniques. This is an up-stream part of exploitation process. Again, this is more expensive than lifting conventional petroleum, but for example, Canada's Athabasca (Alberta) Tar Sands is one example of unconventional reserve that can be economically recoverable with the largest surface mining machinery on the waste landscape with important local but also global environmental impacts. The similar technology of up-stream process concerns oil shales. The downstream part process of solid unconventional oil is an energetically difficult process of separation and refining with important increasing of additive carbon production and increasing of final product costs. In the region of Central Europe is estimated the mean volume of 168 million barrels of technically recoverable oil and natural gas liquids situated in Ordovician and Silurian age shales in the Polish- Ukrainian Foredeep basin of Poland.

Key words: *unconventional oil, tar sands, oil shales, surface mining, extra heavy oil,*

Introduction

The world population is over 7.3 billion and energy demands per one person have increased, for example, in the EU; the energy demand is 125 kWh per person per day (Rybár et al., 2015). The use of energy source is part and also the condition of development of humans and human society. Since, in the broader understanding, the energy may be considered as the equivalent of change, and then also the development of human society into social and technically more complicated forms as well as the growth of human population means that human society must use more energy to cover its needs, from ever increasing portfolio of energy sources.

Given the fact that the energy sector is becoming complicated by the use of a variety of sources in always less available forms difficult of exploitation technology, it is necessary to include and specified conventional-unconventional fuel forms differences.

The most important raw energy material is oil. Global energy consumption is covered by oil to 40 % and in transport fuel to 90 % (Csikósová et al., 2014). Every country is oil depended. Raw material and energy sources claim to increase, especially in the field of energetic, traffic, chemical industry cause the increase of the press of oil supply, particularly in OECD countries and dynamically grows economies as China and India. Because of the unfavourable distribution of oil deposits and reserves in the world, they are more common exploited or evaluated oil deposits which have been unexploitable or limited exploitable. A major part of those are unconventional resources.

Hydrocarbons energy sources classification and characteristic

Energy raw materials are minerals, from which is possible to obtain energy. Some of them are also used in other industrial branches. According to their origin, raw energy materials may be divided into two basic groups: kaustobiolits and radioactive raw materials (geologie.vsb.cz, 2016). Fossil fuels are flammable hydrocarbons incurred via necrotic ancient organic substance accumulation. According to (geologie.vsb.cz, 2016), it is possible to divide it into the coal branch, where peat, lignite, sub bituminous coal, hard coal, anthracite belong (Blišťanová, Blišťan, 2013), (Blišťan, Blišťanová, 2009); and bituminous branch where crude oil, tar sands, oil shales, natural gas, metan hydrats, ozokerite, mineral waxes and asphalt belong. Individual fuel belonging to the caustobioliths are hierarchically arranged according to their market value and density expressed through °API in Fig. 1.

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The petrol characteristics listed in (geologie.vsb.cz, 2016) states that petrol is a liquid composed by gaseous, volatile and solved solid hydrocarbons mixture with non-hydrocarbons organic compounds and sand. Depending on basic hydrocarbons content, oil can be divided into paraffinic oil, naphthenic oil, and aromatic oil. Depending on gravity, oil is divided into extra light oil (less 0,85 g/cm^{-3}), light oil (about 0,88 g/cm^{-3}), heavy oil (up 0,9 g/cm^{-3}). As conventional oil, we can denote that liquid oil is lighter than water (1 g/cm^{-3}, or in API gravity more than 10°API), of which 20–30 % of the oil in place may flow naturally from the borehole because of the pressure within the reservoir or can be pumped by simple mechanical force (primary recovery) (statoil.com, 2016). These oils are liquid and therefore able to migrate in deposit, what is necessary for exploitation via wells. As reported in sources (geologie.vsb.cz, 2016) and (statoil.com, 2016), unconventional oil is extra heavy oil, tar sands and oil shales. Extra heavy oil is material on the limit of oil and tar sands. Unlike of bitumen in tar sands, the extra heavy oil is less viscous and moves in the deposit. Density is up to 1000 kg·m^{-3} and chemically is asphalt-like. Extra heavy oil contents asphaltenes and resins. Due to the high content of aromatic, cyclic, and high-molecular hydrocarbons, a boiling point is high. Extra heavy oil contents high level of sulphur and some metals.

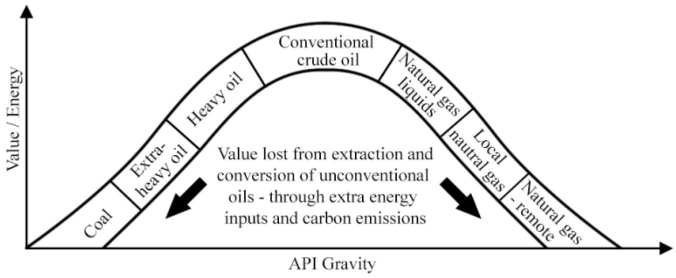

Fig. 1. Hydrocarbon fuels value and gravity hierarchy (processed according to (statoil.com, 2016)).

Extra-heavy oil (non-bitumen) is recorded in 166 deposits worldwide, the largest in eastern Venezuela's Orinoco Oil Belt. The deposits are found in 22 countries, with thirteen of the deposits located offshore (bp.com, 2011). In Orinoco oil belt in Venezuela, there are extractable reserves of about 513 billion barrels of extra-heavy oil. According to (geologie.vsb.cz, 2016), 157 million barrels were exploited in 2009.

The particularly important unconventional oil form is tar sand. It is a sedimentary mineral composed of clay, quartz sand, trace minerals, bitumen and water. Sulphur content can be more than 7 percent. Oil sand is a compact, solid material. According to (geologie.vsb.cz, 2016) the share of bitumen represents 1 to 20 %. Bitumen is made up of organic components ranging from methane via through the simplest organic molecule to large polymeric molecules. This extremely complex hydrocarbon mixture can be synthetically processed into oil (worldenergy.org, 2007). Bitumen are not soluble in water, completely or partially of the benzene-soluble, chloroform, carbon disulphide and other organic solvents, the density is about 0,95-1,50 g/cm^3. Bitumen has a such high viscosity that it does not migrate in the deposit. According to (geologie.vsb.cz, 2016), approximately 1.16 barrels of bitumen are needed for 1 barrel of oil production. Tar sands are products of petroleum-underground water alteration or its breakdown via bacterial activity. These processes reduce the hydrogen content and increase the content of heavy hydrocarbons via decomposition of the low molecular weight substances. Tar sands contain chemically cyclic terpenes, and the asphaltenes, and have high contain of sulphur and some metals.

According to (Rybár, 2012), in the case of the most important world deposits in Alberta, Canada, the share of bitumen ranges between 10-12 %, mineral component from 80 to 85 % and water 4-6 %. To produce one barrel of crude oil, it is necessary to make two tonnes of the tar sands. The tar sands deposits are found in 70 countries worldwide. The greatest reserves are in Canada and Venezuela.

According to (web.anl.gov, 2016), the estimated technically exploitable world's reserves of heavy oil are at 434 billion barrels, and those of bitumen are 651 billion barrels. 81 % of the world bitumen reserves are located in the Canadian province of Alberta. These deposits are: Athabasca, Wabasha, Cold Lake and Peace River. Canadian deposits have a total area of 77,000 square kilometres. Economically recovered reserves in Canada currently representing 280 to 300 billion barrels, which is more than Saudi Arabia oil reserves (264.2 billion barrels). According to "more cautious" estimate published in (web.anl.gov, 2016), the total oil stocks in Canada (oil + tar sands) are at the level of 179 billion barrels.

Bitumen cannot be transported to market by pipeline without adding diluting agents, such as gas-processing condensates including the diluent pentanes plus to meet pipeline density and viscosity limitations. A large portion of Alberta's bitumen production is currently being upgraded to synthetic crude oil and other products before shipment to refineries (2.bp.blogspot.com, 2016).

Outside of Canada, 21 other countries have bitumen resources, including Kazakhstan (in the North Caspian Basin), Russia (in the Timan-Pechora and Volga-Ural basins), Venezuela, and Africa, including the Republic of

Congo, Madagascar, and Nigeria. In the United States, oil sands are deposited in at least a dozen states, including (in relative order) Alaska, Utah, Alabama, California, Texas, Wyoming, Colorado, and Oklahoma. However, the U.S. and other nations' oil sand reserves are currently considered to be far smaller in volume than Canada's reserves and may also be less easily recovered due to different physical and chemical compositions. (2.bp.blogspot.com, 2016)., (Gordon, 2012). According to (www.boell.de, 2011), of the 24 states in the United States that contain tar sands, about 90 % of such deposits are in the state of Utah. The hydrocarbon resource locked in the Utah tar sands has been estimated to be in excess of 25 billion barrels. However, the Utah tar sands, being of non-marine origin, have somewhat different chemical and physical characteristics than the Athabascan sands which are of marine origin and do not respond as well to the traditional process used to extract oil from tar sands. Utah tar sands are generally hard consolidated sandstone closely associated with petroliferous material (heavy viscous oil material) which is as high as 13 % by weight with an average of 10.5 % by weight hydrocarbon. The oil is about 13°-18° API gravity and contains low amount of sulphur, e.g. less than about 0.9 % by weight, low aromaticity and low water content. The Athabascan sand has an encapsulating water film surrounding each sand grain, which makes it amenable to a water-wetting process. The absence of this water film on the Utah sand grain necessitates using other technology for extracting the oils. A comparison of the Athabascan tar sands with a sample of Utah tar sands obtained from Asphalt Ridge is shown in Tab. 1.

Tab. 1. A comparison of the Athabascan tar sands with a sample of Utah tar sands obtained from Asphalt Ridge. (www.boell.de, 2011).

Components	Athabasca Sands	Asphalt Ridge Sands
Carbon [wt-%]	82.6	84.4
Hydrogen [wt-%]	10.3	11.0
Nitrogen [wt-%]	0.47	1.0
Sulfur [wt-%]	4.86	0.75
Oxygen [wt-%]	1.8	3.3
Average Mol. Wt (VPO-benzene)	568	820
Viscosity (poise) **77°F** (cone-plate at 0.05 sec)	6,380	325,000
Volatile material (535°C) [wt-%]	60.4	49.9

Another form of an unconventional oil is the oil shale. Oil shale is relatively hard pale grey to black mineral. This is a sedimentary mineral (calcareous mudstone) containing an organic component. It is mostly composed of clay, silt, and salts, with a small (12 percent) share of insoluble organic matter (kerogen) and even smaller (3 percent) share of soluble bitumen (Patent WO 2004007641 A1). Kerogen is a naturally occurring insoluble fraction of a complex organic matter in the sediments. Kerogen is formed of polymerised substances with high molecular weight, as compared with bitumens. It is insoluble in non-polar organic solvents and non-oxidizing acids. Organic matter share in oil shale is about 15-30 % (Attwood, 2006). Kerogen is disposed between the individual shale layers 20-30 μm thick. By heating to a temperature of 250 to 450 ° C, the kerogen is converted into pyrobitumen and the temperature is raised to 250 to 450 ° C (according to (Lintnerová, 2009) 447 ° C), and the oil (shale oil) and gas were released from pyrobitumen. The best quality raw material contains up to 250 kg of oil per tonne of overburden (Lintnerová, 2009), (Dvořák, Marvan, 1987). The organic kerogen, once extracted and separated from the oil shale, can be processed into oil and gas. Like oil sands, oil shale has similarly high sulphur content, up to 7 percent (cem.msu.edu, 2016). The World geological reserves of the oil shale are, according to (Dynl, 2005) estimated at 300 billion tonnes of which about 30 billion tonnes are technically suitable. According to (Dvořák, Marvan, 1987), reserves are estimated up to the level of 10^{16} t.

According to (2.bp.blogspot.com, 2016), kerogen has the potential to be one of the largest unconventional hydrocarbon resources in the world. In North America, the richest and thickest oil shale deposits are in the Green River Formation, which covers portions of Colorado, Utah, and Wyoming. Prudhoe Bay, Alaska. Additional basins in Colorado (Piceance), Utah and Colorado (Uinta), and Wyoming (Washakie) are also known locations of oil shale. Green River oil shale is a petroliferous material (heavy viscous oil material) which is as high as 25 % by weight with an average of 12 % by weight hydrocarbon. The recovered oil is about 17°- 25° API gravity, frequently averaging about 21° and contains a low amount of sulphur and low aromaticity. The Green River shale has a relatively high moisture content of between 0.4 % to 6 %. Ranges for analysis of several samples of Green River oil shale are shown in Tab. 2. The balance of the components, not shown in the table, are made up primarily of various minerals and trace metals.

A block of U.S. states bordered by Michigan, Missouri, Alabama, West Virginia, and Pennsylvania contains a grouping of large oil shale plays, that is, promising areas targeted for exploration. Internationally, Brazil, Israel, Jordan, Sumatra, Australia, China, Estonia, France, South Africa, Spain, Sweden, and Scotland all have notable oil shale deposits (Klenovčanová, Imriš, 2006), (eia.gov, 2016).

Probable discovered commercial reserves, meaning the quantity that can be recovered economically from a mineral deposit at current prices with current technology, are shown in Table 3 by energetic values (Klenovčanová, Imriš, 2006).

Tab. 2. Ranges for analysis of several samples of Green River oil shale.

Components	**Green River Oil shale** [wt-%]
Carbon	9.1 - 19.6
Organic Carbon	6.7 - 15.7
Hydrogen	1.1 - 2.0
Nitrogen	0.2 - 0.7
Sulfur	0.9 - 3.4
Fishery Assay	
Oil	3.4 - 11.6
Water	0.4 - 5.9
Residue	83.4 - 91.0
Gas liquor	0.8 - 3.3
Gas and loss	2.1 - 4.1

Tab. 3. Discovered commercial reserves of oils (probable - Z2).

Fuel	**Discovered commercial reserves**
	EJ (10^{18} J)
Conventional crude oil	6,835
Tar sands / extra heavy oil	2,720
Oil shale	42
Total oil	9,597

Tar sands and oil shales exploitation specifics

In the case of heavy types of crude oil it is a viscous fluid, and in the case of shale and sand, it is the solid mineral from which the oil needs to be extracted.

The use of unconventional oil resources, in aspect of current methods of exploitation characterized by a higher level of technological and economic performance of mining and processing of raw materials in comparison to the conventional resources, what is largely connected to their physical features - for heavy oil high viscosity and a high percentage of heavy fractions, makes that the final price of a barrel of oil reaches the level of 10 to 20 USD higher as compared to the barrel of "light sweet" crude oil from Saudi Arabia. In the case of tar sand and oil shales, it is a specific physical join on the mineral phase.

There are two ways to realise solid oil sources exploitation. The first is analogical with tercial recovery methods used in heavy and extra heavy oil deposit exploitation. The steam injection or *in situ* production method includes several operations. The up-stream part of the exploitation process includes drilling technology and equipment using is shown in Fig. 2.

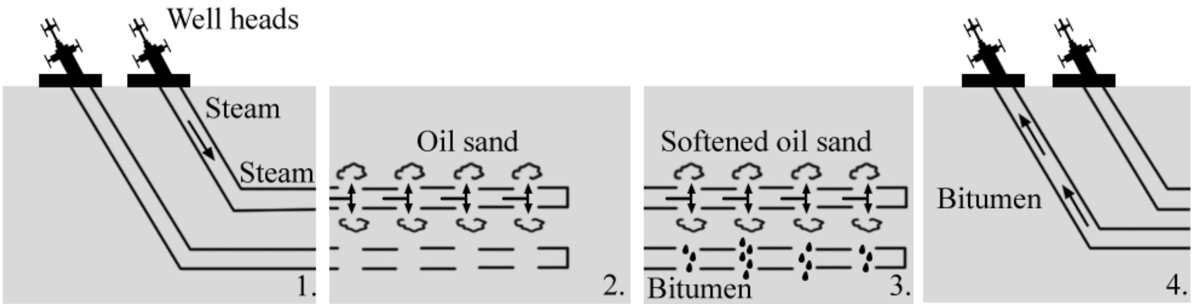

Fig. 2. Up-stream part of in situ production method exploitation process operations.

in situ production method up –stream operations

1. A pair of wells are drilled, and high-pressure steam is injected down the top well and into the oil sand deposit.
2. Steam enters the sand through pipes perforation. Bitumen is softening by heat and water vapour dilutes and separates it from the sand.
3. A mixture of bitumen and water collects in the bottom well.
4. The mixture is pumped up to the surface for up-stream processing operations.

Down-stream part of in situ production method, which includes transportation treatment and refining technology and equipment, is shown in Fig. 3.

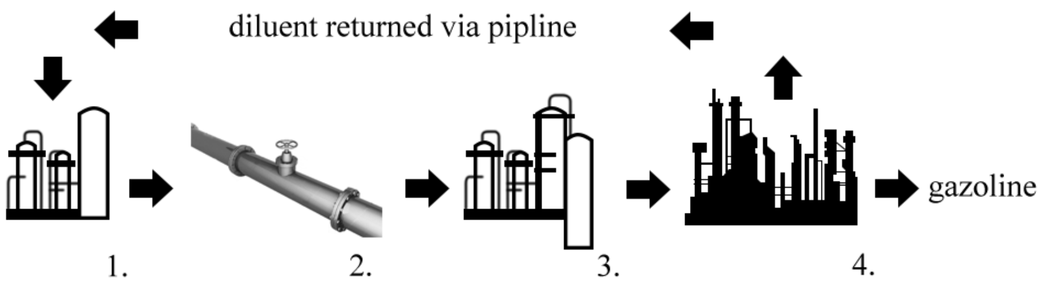

Fig. 3. Down-stream part of in situ production method.

down –stream operations

1. Dilbit creation (bitumen is diluted with one or more lighter petroleum products), what makes diluting bitumen much easier to transport in pipelines.
2. Dilbit transport via pipeline.
3. Upgrade to synthetic crude oil.
4. Refinery production.

The second way of tar sands exploitation is of unconventional oil forms exploitation such as oil shales and tar sands is the application of the principles of open-cast mining, the base of what is a correct understanding of the dynamics of these processes. Workplaces are not made in one place but are moved. The movement and progress of the work depend on the type of the surface, the volume of raw materials and the capacity of the technology used (store.hartenergy.com, 2016), (globalmethane.org, 2016).

Workplaces where the work operation is ongoing (mining, loading) are moved in space with a certain speed, which is proportional to the capacity of the technology used (machine), and inversely proportional to the volume of extraction.

In the case of tar sand exploitation, the process consists of the following operations (Fig. 4), which are analogous to the up-stream part of in situ production method:

Open-pit mining up –stream operations

1. Deposit area surface striping; the process of several tens meters of peat layer removing from deposit body (dozers and excavators are used).
2. Mined material (tar sand) is digging by excavators and loaded to dumpers.
3. The material is removed to the crusher to break up lumps and remove rocks.
4. The tar sand is mixed with hot water to create a slurry mixture and transported by pipeline to an extraction plant.
5. The slurry enters to a separation vessel, where solid part – sand settles to the bottom and bitumen with air bubbles forms a froth on top of the water.
6. Bitumen froth is separated, mixed with a solvent and separated in a centrifuge from water and clay solids process tail.

Down-stream part production includes transportation treatment and refining technology and equipment analogical as of in situ production method, and it does not represent mining operations but processing and refinery technology.

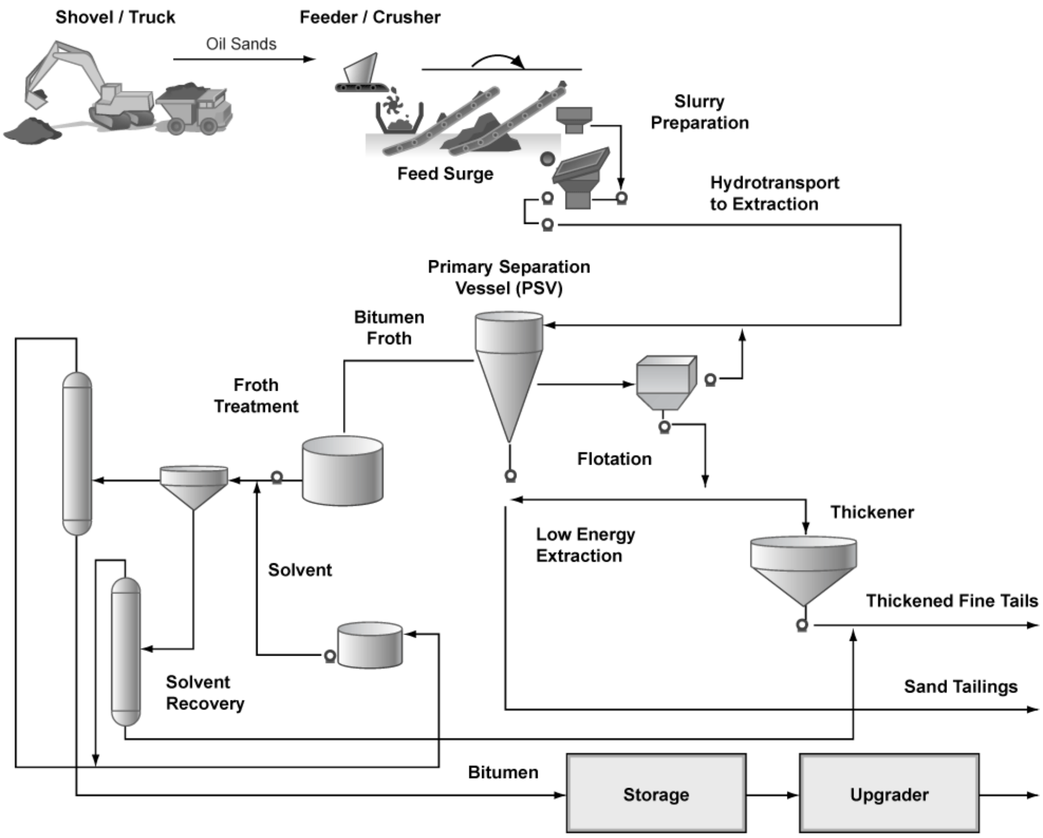

Fig. 4. Up-stream part of open-pit mining production method - oil sands mining and extraction. (Cehlár et al., 2013).

For up-stream operations evaluation, it is important to make quantification of several representative parameters. According to (Jurkasová et al., 2016), a ratio of the waste V volume or weight for the specified period and the economic mineral R for the same period can be represented by mining (current) stripping coefficient k_{exp}.

$$k_{exp.} = \frac{V}{R}, \qquad m^3/m^3, t/t \qquad (1)$$

The current stripping coefficient is often referred to in the bibliography as (Jurkasová et al., 2016), most often with statistical indicators of the mine for the specified period. The ratio of the total waste ∑V volume or weight and the total economic mineral ∑R volume or weight in the limited open-pit mine represents a medium stripping coefficient, k_{pr}..

$$k_{pr} = \frac{\sum V}{\sum R}, \qquad m^3/m^3, t/t \qquad (2)$$

If the initiation of quarry building is considered, the medium stripping coefficient is a sum of investment k_o and mining coefficients.

$$k_{pr} = k_o + k_{exp.} \qquad (3)$$

Ratio of the investment stripping V_o volume or weight and the total amount of the bitumen mineral in the limited open-pit mine ∑R represents investment stripping coefficient k_o:

$$k_o \frac{V_o}{\sum R}, \qquad m^3/m^3, t/t \qquad (4)$$

The stated stripping coefficients show to what extent the investment stripping burden each unit of the economic mineral in the limited open-pit mine.

A level of up-stream operations and costs, as well as energy consumption for its realisation, is closely connected with deposit body position conditions. In a case of horizontally posed plate-like deposit body suffice used stated parameters as stripping coefficients. In the case of declined deposit body, it is necessary to analyse additional aspects that affect stripping coefficient value evolution in the time scale of deposit exploitation.

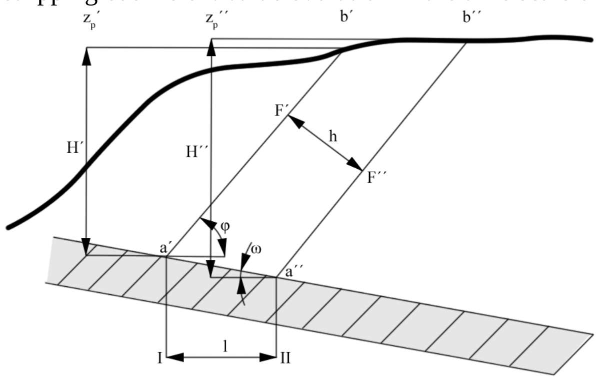

Fig. 5. Calculation of a stripping volume on horizontal and slightly inclined deposits between the position I and II. h – thickness of overburden shifting between the positions I and II, ω- economic mineral deposit gradient angle , φ- a quarry working zone slope gradient angle, H´-H´´- depth (height) of spoil between position I and II, l – horizontal projection of the overburden shift between position I and II.

The appraisal of the stripping volume on the development from the position I to the position II in the case of slightly inclined deposits (Fig. 5) results from the relationship:

$$V = \frac{F' + F''}{2} h \quad , \quad m^3 \tag{5}$$

F´, F´´- surface of a stripping working zone [m^2]

$$F' = \frac{L'_p + L'_{kr}}{2} \overline{(a'b')} \quad , \quad m^2 \tag{6}$$

$$F'' = \frac{L''_p + L''_{kr}}{2} \overline{(a''b'')} \quad , \quad m^2 \tag{7}$$

$$\overline{a'b'} = \frac{H'}{\sin \varphi'} \quad , \tag{8}$$

$h = I (1 + tg\omega ctg\varphi) \sin\varphi$,

ω is an economic mineral gradient angle and φ working platform gradient angle.

The volume between position I and II:

$$V = \frac{F' + F''}{2} I(1 + tg\omega ctg\varphi) \sin \varphi \quad , \tag{9}$$

$$F' = \frac{L'_p + L'_{kr}}{2} H' \quad , \tag{10}$$

$$F'' = \frac{L'_p + L''_{kr}}{2} H'' \quad , \tag{11}$$

L_p, L_{kr} – length of the working face of winning operations on the terrain and overburden surface of the economic minerals [m].

According to (Jurkasová et al., 2016), in the case of a fan-like and combined advance of the face, during the creation of the chart of the winning operations mode, the volume of stripping shall be determined in dependence on the surface shape. The total amount of stripping and the economic minerals does not depend on the mode of winning operations. However, the mass distribution and the mode of winning operations depends significantly on the thickness of spoil and economic minerals in particular parts of the open-pit mine that are subject to geometric analysis. An important aspect which the analysed parameters depend on is a mining equipment size selection process. The complex process of equipment size criteria is shown in Fig. 6.

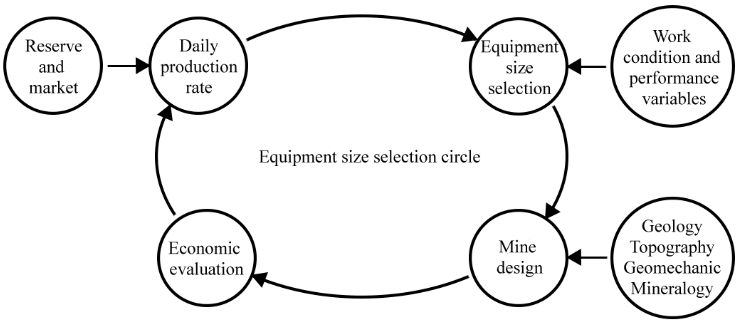

Fig. 6. The equipment size selection environment in open-pit mining.

The principal surface mining operations are loading and hauling. The size of haulage machines directly influences the mine layout and design, and loading and haulage should be adequately matched. Haulage costs are usually twice the cost of loading; consequently, greater attention must be paid to truck selection. According to (Cehlár, 2006), the parameter which represents the ratio of loader productivity to hauling productivity is a Match Factor (MF). A low MF (< 0.5) suggests that the loader is not working at capacity, whereas a high MF (> 1) suggests the truck fleet is smaller than necessary to maintain a productivity balance between truck and loader fleets (Fig. 7).

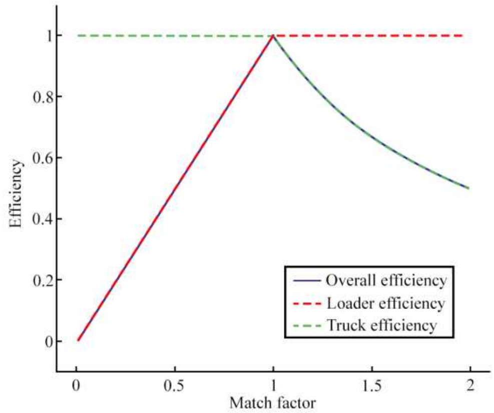

Fig. 7. Match Factor as a ratio of loader productivity to hauling productivity.

Machinery and equipment operating in working face (block, bench) will move to different work conditions (due to the variability of physic-mechanical properties of the mined material), so it has to work reliably in a wide range of these properties. To release the mined material from rock mass, the machine need to overcome resistance (cutting resistance) in the case of tar sands and use special methods as blasting for shales. The machine must be equipped with a self-power drive, and advance speed can be increased by increasing the capacity of the machine (store.hartenergy.com, 2016).

In the example of Syncrude Oil exploited deposits in Alberta, tar sands layers are located under an overburden layer about 50 m thick. Therefore a large part of mining operations is deposit striping. Tar sand mining method is based on the cyclical method of surface mining with the following machine equipment (Syncrude Oil, Alberta), according to (Jurkasová et al., 2016): Electric roap shovels P&H 4100 BOSS, Hydraulic shovels Terex/O&K RH 400, Dumpers Caterpillar 797 a 797B, Komatsu Haulpak 930E. Primary cylinder crusher Krupp MMD 1500 (plant processes 12 000 tonnes per hour of material). Transport of crushed materials into the primary separation unit (Primary Separation Vessel - PSV) is realised either via belt conveyors (with a capacity of over 7,000 tonnes per hour) or at Syncrude's Aurora Mine pipeline (with a capacity of more than 8 000 tonnes of slurry per hour). The PVS separation of the bitumen is realised by hot water and is connected which other refining processes, which result in a synthetic crude oil. Mining costs are about 10 USD per barrel of synthetic crude oil.

Promising unconventional oil deposits in Central Europe (EU)

If based on data published by the USGS 0, i.e. using a performance-based geological assessment methodology, the U.S. Geological Survey estimated mean volumes of 168 million barrels of technically recoverable oil and natural gas liquids in Ordovician and Silurian age shales in the Polish- Ukrainian Foredeep basin of Poland (Fig. 8).

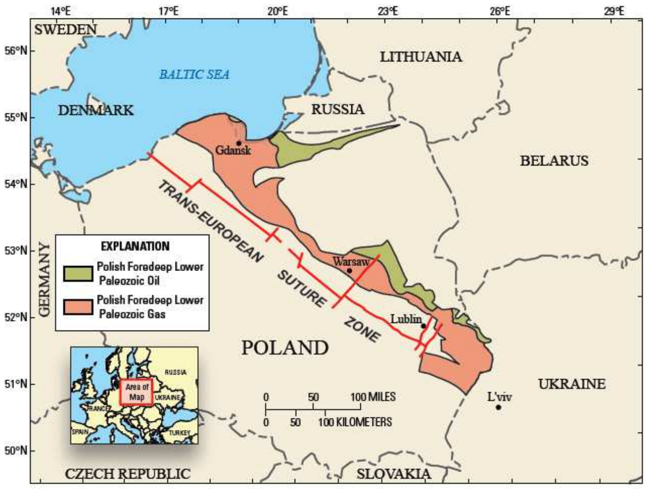

Fig. 8. Map showing the assessed areas in the Polish part of the Polish-Ukrainian Foredeep Basin.

Potentially productive organic-rich shales of Ordovician and Silurian age occur below the surface of the European Plain in a band 20 to 200 km wide that extends from beneath the Baltic Sea north-west of Gdansk southeastward across Poland in the vicinity of Warsaw and Lublin and into western Ukraine near Lvov and beyond.

According to (pubs.usgs.gov, 2016), potentially productive strata range from tens to hundreds of meters thick, including, in places, almost 100 meters of black marine shales. Technically recoverable shale oil resources in the Polish sector of the Polish-Ukrainian Foredeep basin according to data published in (pubs.usgs.gov, 2016) is the estimated resources, recoverable with existing technology, range from 0 to 172 million barrels of oil, with a mean estimate of 62 million barrels; and from 0 to 368 million barrels of natural gas liquids with a mean estimate of 106 million barrels.

Determination of the reserves was based on data coming from the 56 wells completed before 1990. Further drilling has been realised since 2008, but those results have not yet been published (Poprawa et al., 1999), (Bittner et al., 2015).

Conclusion

The importance of unconventional oil currently growing dynamically, while tar sands in Canada's Athabasca deposits in Alberta, for example, according to analyses of the bank CIBC World Markets as described in (Teplická et al., 2015) provides the largest contributor to global growth in oil supplies at the moment.

It can be said that the net increase in oil production will already come from unconventional sources, supported by the analysis of 164 new oil fields and new projects. More than 60% of the 3.6 million barrels of oil production in 2006 only replaced the out extracted fields in the North Sea and the Burgan in Kuwait.

Obviously, the Canadian bituminous sands are one of the world's most important sources of oil, but also one of the few investment open to private capital. Planned exploitation of bituminous sands in Alberta over the next decade may even exceed the growth of oil production in Saudi Arabia.

In proportional view, analogical local energy stimulus in Central Europe can be the recovery of shale deposits located right in the Polish part of the Polish-Ukrainian Foredeep Basin, which is certainly an important internal source of oil in central-European part of EU. On the other hand, there are obvious differences in the exploitation of these unconventional sources using of extraction methods and application of machinery known from surface brown coal mining as in Poland, Czech Republic or Germany.

When considering the eventual use of such deposits, it is also necessary to calculate with significant up-stream activities, due to energy-intensive processes reflected in the environmental side of raw material exploitation. If it is possible to use analogy subbituminous coal surface mining for the up-stream activities, then in the case of down-stream phases, it is necessary to assess each project individually, taking into account the specificities of a particular economic mineral of deposit and a legislative framework of that country.

If we assume technological specifics of exploitation and a high degree of energy consumption of subsequent treatment processing, then obtaining oil from unconventional sources is one of the factors that should be reflected prospectively increasing pressure to temporarily increase the current low oil prices on world markets.

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