Fine Coal Waste Utilisation

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Abstract

The most frequent solution of water-slime industry in mines and companies working on coal output enrichment is linking watercourses from individual technological nodes into one stream of water-slime slurry. The outcome of such solutions is water-slime mixture of averaged composition and physicochemical properties.
Depending on the applied slurry dewatering methods, we obtain cakes of slime coal mixtures or/and, in the case of gravitational dewatering of slurry in settlings, slimes diversed in composition in relation to the place of sedimentation.
Among all studied various methods of coal concentrates extraction from slime – water slurries, the most interesting results are these of industrial significance obtained on mesh sieves. The new production of arched and centrifugal sieves (the so-called OSO),with minimum mesh size, enables selective coal concentrates extractions from coal slimes. The recovery of coal concentrates from postflotation wastes is more difficult and most often the best results are ensured through application of flotation processes.
The conducted research of fine-grained coal wastes and side products of coal combustion lay a fundament to elaboration of new technology, pilot installations and industrial implementation.

Keywords: coal slime, flotation waste, fine coal waste, incerasing calorific value

Introduction

In conditions present in mines and coal enrichment companies the substantial share constitutes fine grained coal wastes which differ not only in their origins, but also in their physochemical properties [14]. Among them we can enumerate:

– coal slimes extracted from water slime industry,

– post flotation wastes from flotation processes of coal enrichment,

– coal slimes, post flotation wastes and their mixtures accumulated in on-ground settlings,

– slimes obtained from pit drain-ways and surface pit water settlings.

Fine-grain coal wastes, in particular coal slimes and postflotation wastes, are not only applied as low calorific fuels (independent and/or as a supplement to commercial fuels), but also as technological fuel (a supplement to ceramic mass and clinker) and the source of coal concentrates as well as material insulat-ing/caulking mine excavations, coal pile surfaces, wastes storage and as an agent to light soil melioration etc.

An important step in development of mass exploitation of low calorific fuels was its incorporation to boilers and furnaces with fluidized beds, which allows waste combustion of calorific value of 5,5 MJ/kg; most of them is featured with calorific values exceeding 8MJ/kg, though [9].

Growing restrictions in relation to gas emission pollution to environment and the necessity for eco-nomic improvement during combustion processes indicate purposefulness of analysis of existing solutions in order to prepare and apply low calorific fuels and to elaborate new approach in actions taken to further improvement.

The elemental components of fine grained coal wastes are mineral components (marked as ash) and coal substances (maceral) and water, which amount varies significantly depending on emission technology of fine grained coal wastes as well as on method and time of its deposit etc. The main factors, which de-termine energy production properties of fine grain coal wastes, are kind and quantity of maceral.

From power engineering point of view, the most significant requirements imposed on fuels is among others their combustion heat, calorific value, sulphur content and water content (humidity) and ash. These relations are well specified by the relation between calorific value and combustion heat and ballast con-tent, i.e.

$$Q_{i^r} = Q_{s^{daf}} - \alpha \left(A^r + W_{t^r} \right) \qquad (1)$$

Q_i^r – calorific value in working condition, kJ/kg
Q_s^{daf} – combustion heat in ashless and dry condi-

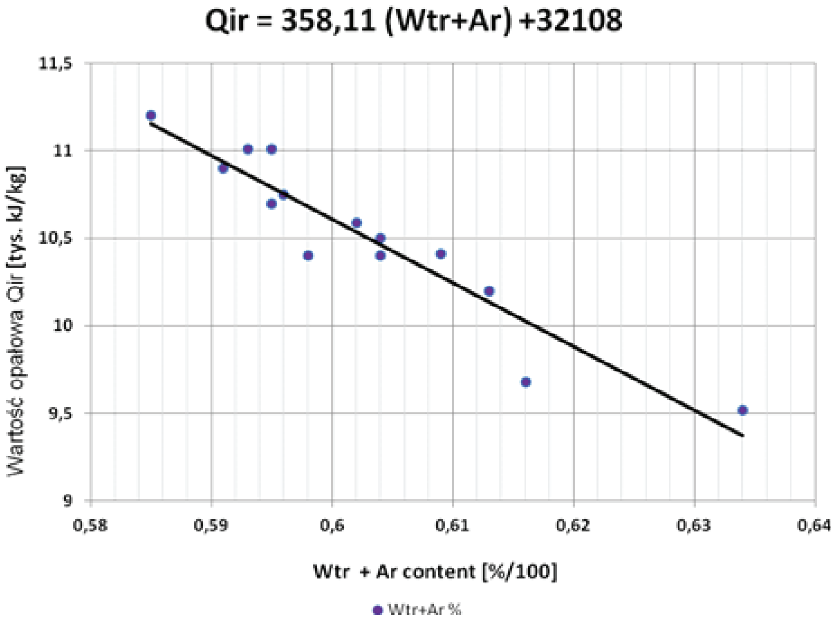

Fig. 1. Calorific value vs ballast content

Rys. 1. Wartośc opałowa zw zalezności od zawartości popiołu

tion, kJ/kg
A^r – ash content, %
W_t^r – humidity level, %
α – proportion coefficient for a given kind of fine grain coal wastes, kJ/kg/%

In the case of coal slimes deriving from fire coal production type 31.2 in specific mine, these relations are presented in figure 1 [8].

Mineral components (ash and water), present in fine grain coal fractions, cause decrease of energy val-ue (calorific) of maceral. In the event of pyrite compound occurence, the energy effects from maceral combustions are enriched due to egzothermic reaction of sulphur oxidization into SO_2. The substantial position of endothermic processes and physical properties of mineral components is their specific heat which equals 0,899 kJ/kg.deg. on average.

Humidity also causes decrease in calorific value of fine grain coal fractions due to temperature increase and water evaporation. Specific heat and evaporation heat equals respectively cw= 4,18 kJ/kg.deg and qpw = 2.260 kJ/kg which means that every kilogram of water present in fuel absorbs approximately 2.600 kJ/kg.

The analysis of properties and composition of fine grain coal fractions shows that reasonable use of them as a source of heat energy requires alternations to their composition which leads to increase in share of organic coal mass and at the same time decrease of water and/or ash content.

Current processing solutions in mines and enrichment companies do not guarantee substantial increase in power value of produced fine grain coal wastes. Acquiring significant increase of power value of cur-rent coal slimes, postflotation wastes etc. requires incorporation of new solutions in technological and or-ganizational procedures.

These actions deserve attention due to the fact that in black coal mining and local government respon-sibility, there are already accumulated significant amounts of fine grain coal wastes, amounting to 20 mln tonnes. There also should be additional 5 mln t. included due to ongoing production. Slime coal of calo-rific value below 10 MJ/kg is in greatest volume.

Material presented constitutes an analysis of selected research results and incorporations as well as studies on possibilities of quality increase of fine grain coal wastes and rationalization of its use in energy industry.

Research and incorporations connected with decrease in humidity of fine grain coal wastes

Research and attempts of water content reduction in fine grain coal wastes were conducted and as-sessed with filtering devices in the process of feed granulation for filtration, influence of ionic surfactants, application of flexible water permeable tanks and application of chemical dewatering agents.

In the case of selected fire coal mine, the emerging coal slimes were featured with high contents of ballast (water + ash). Slime water slurry was concentrated in radial densifier Dorra and subsequently di-rected into parallel working filtering devices. The yearly average of water content in cakes from the chamber filter press amounted to 29,2%, whereas cakes from belt filter contained 40,9%. In the analysed conditions, usage of belt filter caused increase in slime volume to store of 12% of mass and decrease in slime energy value of 1.375 kJ/kg, in comparison to cakes from the chamber filter press. Substitution of belt filters with new chamber filter press enabled further decrease in water to approximately 24% of mass.

Additional application of sedimentation centrifuge sieve-sieveless to dehydration of coal slimes al-lowed for even greater results, as in parallel with dewatering the process of slime unloaming occurs. The recovery of dewatered slime is 75% with calorific value exceeding 14.000 kJ/kg, from feed of calorific value 9.5000 kJ/kg [13].

There was also research on influence of slime graining on its dehydration, with the use of flying ash and bottom ash derived from coal combustion in ash furnaces and fluidized-bed furnaces. The verification of the results in industrial conditions confirmed laboratory results. In the case of slime dewatering on belt filter the results were as follow [4]:

– an addition of ash in the volume from 4 to 26% into water-slime slurry with flocculant reduces hy-dration of slime cake by 18 to 34%,

– an addition of ash in the volume from 15 to 26% into water-slime slurry with 50% of flocculant re-duces hydration of slime cake by 34 to 40%,

– an addition of ash in the volume of 15 to 33% into water-slime slurry without flocculant reduces hy-dration of slime cake by 32 to 40%,

– acquirement of cake hydration with ash application proved the possibility to resign from flocculant in water-slime slurry dehydration,

– there are no significant differences in the effect of coal slime dehydration regarding the kind of ap-plied ash.

The trials on the chamber press model demonstrated that addition of ash into slurry is more efficient than on the belt filter. Not only does the addition of ash increase water permeability in mass structure of dewatered slime, but it also changes the structure of cake from paste into densely plastic, even solidified. These experiments are crucial for technology incorporation to safe slime storage in the environment and, alternatively, its usage to recultivate and revitalize polluted areas and to close municipal wastes landfills [12].

The obtained results also indicate a possibility to decide on properties of slime cakes as fuels, through substitution of ash with coal concetrates additive. Moreover, slime slurry containing an additive of calci-um ash constitutes efficient material to its granulation or direct combustion in fluidized-bed furnaces [11].

The influence was reasearched of the addition of 0.1 to 0.3% of ionic surfactant (derivative of fatty alcohol oxyethylene) on slime slurry dehydration with the use of dewatering vibro sieve. In comparable conditions the decrease of water content was obtained of 15 to 20% [8]

The use of chemical agents to decrease water content in coal fuels, including coal slimes/postflotation wastes is practical only when it involves obtaining new properties of the product, for instance:

– structure alteration of slimes from paste into partial/solidified,

– adaptation of slimes to safe transportation and storage (petrification, granulation),

– self heat prevention,

– neutralization of pyrite compounds in fuels.

The most often applied reagents for water bindings in coal slimes are: calx (CaO), semiwater plas-ter/anhydrite ($CaSO_4/CaSO_4.0,5H_2O$), cement, flying and bottom ash of calcium and fluidal kind etc. as well as dry slaked calcium (hydrated) The common feature of all discussed reagents is presence of active calcium compounds (CaO or/ and $CaSO_4/CaSO_4.0,5H_2O$).

Many of them reacts with components present in coal slimes and in the environment, which plays a crucial role in the process of petrification and has impact on properties of obtained products (most often granule) and on processes of their combustion [11], namely among others it comes to:

• Dewatering stage:

$CaO + H_2O = Ca(OH)_2$
$CaSO_4 + 2H_2O = CaSO_4.2H_2O$
$CaSO_4.0,5H_2O + 1,5\ H_2O = CaSO_4.2H_2O$

• Binding of CO_2 aluminosilicates stage:

$Ca(OH)_2 + CO_2 = CaCO_3$
$(SiO_2)n.(Al_2O_3)m + zCa(OH)_2 = (SiO_2)n.(Al_2O_3)\ m.(CaO)z + z\ H_2O$

• Flue gas desulphurisation stage (in the combustion process of coal granular sludge):

Tab. 1. Comparison of the properties of coal slurry, depending on the mode of preparation

Tab. 2. Porównanie właściości zawiesin w zalezności od metody wzbogacania

Coal slurry burned in fluidized-bed boiler	Analytical state					Operating state				
	W^a	A^a	Q_s^d	S_t^a	C^a	W_t^r	A^r	Q_t^r	S_t^r	C_t^r
Jan:										
- ex plant	3,22	56,71	11.129	0,60	29,08	27,5	42,5	7.311	0,45	21,8
- suspension	-	-	-	-	-	40,0	-	5.744	-	-
- granulate						27,0	41,6	7.702	-	-
Sob.:										
- ex plant	4,07	52,54	12.422	0,76	32,20	28,3	39,3	8.211	0,56	24,1
- suspension	-	-	-	-	-	40.0	-	6.584	-	-
- granulate	5,15	42,00	14.738	0,91	39,24	28,8	31,5	9.891	0,68	29,5
Sob. 5 % of slurry to fine coal	8,23	16,24	23.944	1,709	59,82	20,3	14,1	19.525	1,48	52,0

$Ca(OH)_2 + SO_2 = CaSO_3$
$CaCO_3 = CaO + CO_2$
$CaO + SO_2 = CaSO_3$
$CaSO_3 + 0{,}5\ O_2 = CaSO_4$

This way each mol CaO (56) binds one water mol (18 g) which indicates possibility to bond water con-tained in slime in the adequate volume in relation to added CaO and analogously calcium sulfate binds water as well (136 g for every 36 g of water).

Dehydration processes occur simultaneously as a binder of created granules. Obtained calcium hy-droxide after completing a role of being „a binder" undergoes reaction of carbonization and with carbon dioxide creates calcite and by that strengthtens the structure of granules. Longer seasoning of granulated slimes leads to pozzolanic reactions with aluminosilicated contained in ashes and additionally petrificates the structure of granules. Slimes granulated with binders containing CaO causes desulphurisation of fumes in the process of their combustion.

Granulate mechanic endurance grows proportionally to the volume of binder dose and to the time of their seasoning.

Based on current studies and trials, techno-economic assumptions has been elaborated and two instal-lations have been incorporated for constant coal slime cake granulation with two rapid reaction mixers [11, 12].

Application of granulated coal slimes in fluidized-bed furnaces is of particular econimic importance, as well as a supplement to coal culms. Fluidized-bed furnaces are currently equipped with option to prepare water-slime pulp injected into furnace bed. In this situation, coal slime cakes are provided to mines and subsequently hydrated. Then they are processed into pulp with average water content of 40%. Balances investigation shows that granulate coal slime combustion, in comparison to pulp, leads to increase in calo-rific value of combusted slimes of approximately 2.000 kJ/kg and decrease in combustion costs – table 1 [5].

The research regarding increase in content of coal substance in fine grain coal wastes

The aim of conducted studies was to determine possibility and conditions of obtainment of slimes with greater content of maceral,within the area of current solutions of water-slime circulations in mines/processing companies.

On the basis of conducted studies and research on emission of coal concentrates from fine materials and wastes, there were selected and verified through trials among others the following [8, 3, 10]:

– methods of selective emission of courses rich in coal from water-slime circulations,

– methods of grain classification, densimetric and based on differences in surface properties of its components,

– methods of 'deep' enrichment of fine grain mining wastes,

– changes in methods hitherto of water-slime slurry storage in settlings.

The analyses of obtained results from trials and research demonstrate great opportunities to incorporate simple and effective methods of coal substances recovery, in particular selective emissions of rich courses and grain classifications, leading to improvement in economic effects for producents and users of fine grain coal wastes.

Tab. 2. Characteristics of sludge separated from water circuit in coal enrichment plant

Tab. 2. Charakterystyka zawiesin węglowych z różnych punkatach zukładfu technolognego wzbogacania

L.p.	Solid phase	Net Calorific value, kJ/kg		Calorific value, kJ/kg		Ash content, %		Grain class >45 µm
		Solid phase (Slime)	Grain class >45µm	Solid phase (Slime)	Grain class >45µm	Solid phase (Slime)	Grain class >45µm	
1.	**Mine (dewatering pipe)**	6.925	-	11.890	-	30,4	-	-
2.	**Classification +/- 20 mm**	13.787	21.033	16.516	22.000	50,0	31,5	48,5
3.	**Magnetite Recuperator**	10.4546	17.448	11.005	18.275	55,8	35,3	35,6*
4.	**Jig**	14.238	18.407	15.053	19.355	58,0	33,5	63,1
5.	**Dewatering centrifuge**	18.480		19.174		31,0		[53,7]
6.	**Spiral separator**	2.525	22.118	-	23.191	74,5	15,0	[15]
7.	**Radial thickener**	11.903	17.492	12.498	18.341	52,8	34,1	39,6*
8.	**Filter press**	9.863	-	10.471	21.243	57,5	24,3	23,3*
9.	**Slime settling pond**	7.000-21.000 12.465	- 21.315	9.000-25.000 13.136	- 22.315	9,5-70,0 48,0	- 17,9	- [31,8]

Selective emission of fine grain coal wastes from water courses circulations from coal enrichment companies. The water-slime industry in mines is an example of averaging of various quality and composi-tion of courses from individual technological nodes from extraction companies and coal enrichment com-panies and then dewatering of water-slime slurries, which result in slimes of average properties and com-position.

The analysis of solid phase included in water-slime courses show high diversity of their composition and energetic properties regarding the place of their origin – table 2.

The analysis of average research results of solid phase of selected courses, for selected mine, showed the following differences in outcomes (maximum – minimum):

• gross calorific value difference ca. 11 MJ/kg (dewatering centrifuge= 18.480; pit drain way = 6.925 kJ/kg)

• combustion heat difference ca. 9 MJ/kg (dewatering centrifuge = 19.174; filter press, slime cake = 10.471 kJ/kg),

• ash content difference ca. 28% (jigger = 58,0; pit drain way = 30,4%

• content of grain fraction >>45 µm (of coal concentrate) difference ca. 40 (jigger = 63,1; filter press, slime cake = 23,3%

The research results mentioned hereinabove were verified in other mines. The differences were only due to places of occurence of the richest and the poorest courses, which relates to diversive nature of coal properties and technological solutions of their enrichment.

Emission of fractions rich in coal from fine grain coal wastes. The studies of grain composition of fine grain coal wastes demonstrate a regularity, that in coal slimes one can explicitly differentiate grain frac-tions, which are either poor or rich in mineral components (marked as ash), which is shown in figure 2. The most frequent inflection point is slime granulation on the border of 30 to 60 micrometres. Grain fractions exceeding this point contain the lowest presence of ash, i.e. they are featured with the highest calorific value – table 2. In the case of postflotation wastes there is no such explicit correlation between ash con-tent and their granulation.

The possibility and purpose of grain classification of coal slimes has been confirmed for many years and by many facilities. However, it hasn't been incorporated into industries in such great extent. The most commonly presented are propositions of water-slime slurries classification in hydrocyclones and then on spiral separators.

The choice of device used for the reasearch on grain classification was based on quality and quantity requirements of coal concentrates emis-

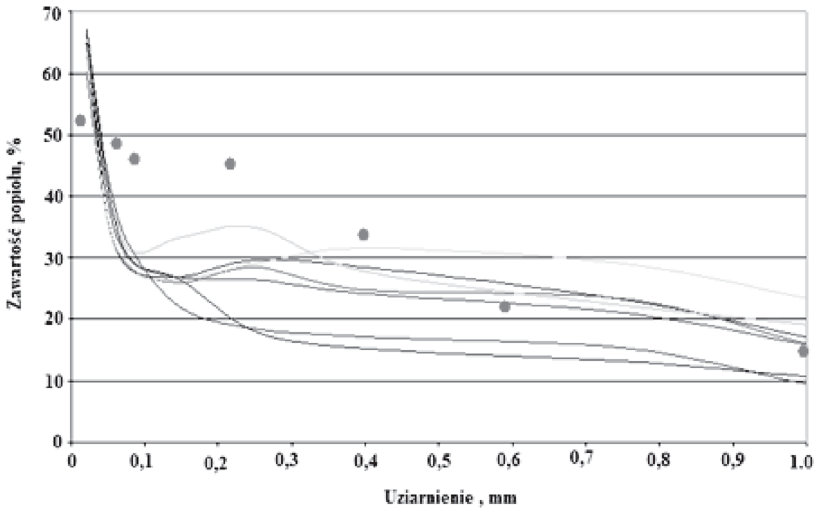

Fig. 2. Ash content vs. grain composition for coal slurries and flotation waste

Rys. 2. Zawartość popiołu w zależności od uziarnienia

Tab. 3. Results of classification of coal slurries on arc screens

Tab. 3. Wyniki klasyfikacji zawiesiny węglowej na sicie łukowym

No.	Parameter	Density, g/l	A^a, %	S^a_t, %	Grain class			
					+ 0,063 mm		- 0,063 mm	
					Contribution, %	A^a, %	Contribution, %	A^a, %
1.	Arc sieve , slot 1,0 mm							
	Feed	-	33,3	-	-	-	-	-
	Coal	-	26	-	-	-	-	-
	Sludge	-	44	-	-	-	-	-
2.	Arc sieve 0,35 mm							
	Feed	26-92	38,0	1,08	35,9	19,0	64,1	54,3
	Coal	46-220	27,6	0,95	57,9	19,9	42,1	50,8
	Sludge	19-87	43,5	1,07	28,3	20,9	71,7	54,3
3.	Arc sieve 0,1 mm							
	Feed	80-120	43,9	0,74	24,6	12,1	75,4	-
	Coal	-	20,1	0,73	78,6	15,4	21,4	-
	Sludge	-	55,7	0,74	8,8	16,8	91,2	-

sion above 0,05 mm. Among numerous methods of grain classifica-tion of coal slimes, the recovery of coal concentrates was carried out on:

– screen type Stack Sizer from Derrick Corporation,

– arched sieve (VariSieve) from Progress Eco SA,

– rapid vibratory screen with textile membrane filter.

Despite satisfactory results of enrichment, there were no studies on application of concentrate tables, as well as of hydrocyclones, spiral separators and gravitational jiggers (TBS Teeter bed separator; hydrosiz-er). Whereas, post flotation wastes underwent separation in centrifuges with high centrifugal force (Fal-con) and oil agglomeration (Otisca) not only for assessment of possibilities regarding concentrates emis-sion but also for assessment of economic benefits arising from such incorporation. Moreover, there was also demineralization and coal desulfurization carried out in the gravimelt process. The latter studies and trials and trials on Stack Sizer screen were conducted in cooperation with creators/owners of the men-tioned processes.

The trials conducted on Stack Sizer screen demonstrated efficiency of the classification process, as well as the process of unloaming the course of extracted coal concentrate with granulation over 0,075 mm. Coal slimes with combustion heat in the frame from 12.807 to 14.622 kJ/kg enabled to extract coal con-centrates with calorific

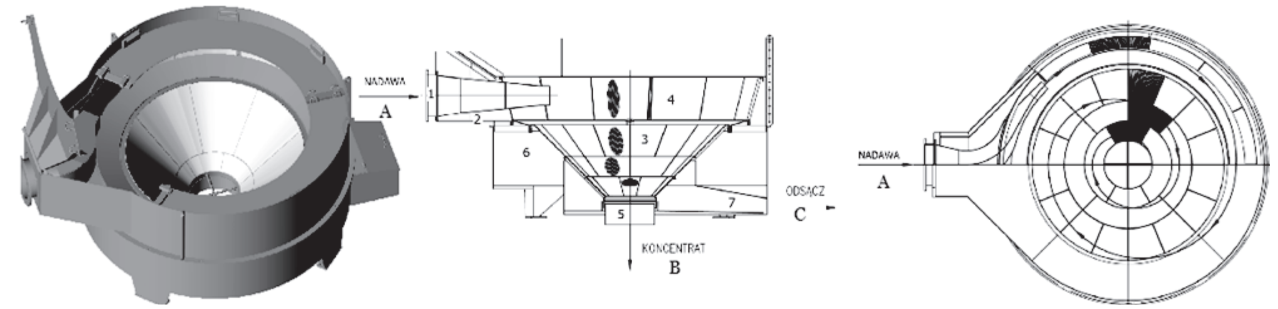

Fig. 3. Centrifugal dewatering sieve OSO
A – feed; B – concentrate; C –filtrate; 1 – feed nozzle; 2 - steering wheel; 3 - slotted centrifugal sieve; 4 - wheel; 5 - outlet dewatered product; 6 - filtrate collector; 7 - outlet.

Rys. 3. Odśrodkowe sito odwadniające
A – Nadawa, B- koncentrat, C- Filtrat, 1 – dysza nadawcza; 2 – obudowa kierownicy; 3 - sito szczelinowe stożkowe; 4 – kierownica; 5 – wylot produktu odwodnionego; 6 – wanna zbiorcza odsącza; 7 – wylot odsącza

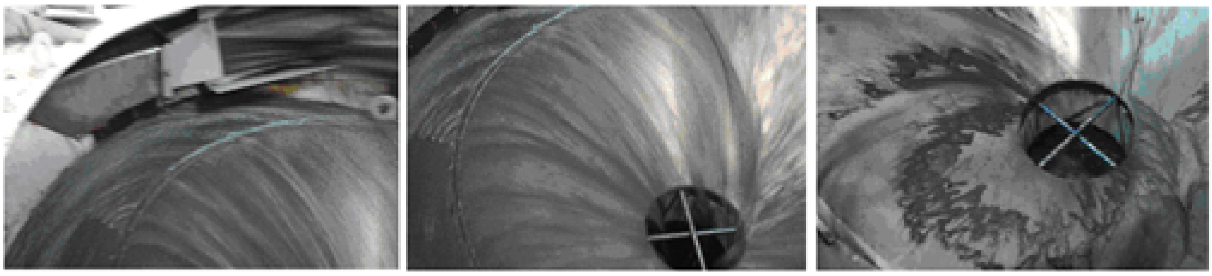

Fig. 4. Centrifugal dewaterinf sieve in work

Rys. 4. Sito OSO w ruchu

value from 14.864 to 25.932 kJ/kg.

In the case of coal concentrates emission, solution of fine grain coal wastes was applied with rapid vi-bratory screen with textile filter screen [1]. Depending on the applied membrane, the obtained coal con-centrate, from studied slime, varied from 6,9 to 11,6% during the process of singular sift, whereas after secondary sift it varied from 7,01 to 19,24%. The results were verified with industrial device.

On the basis of gathered experience, the installation was built, which aim is to recover coal concen-trates from slime extracted from the bottom of lake, where postflotation waste and slime from nearby mines have been accumulating over the years. This installation enabled decrease in ash content by ca. 33 to ca. 22% and increase in calorific value from 15.000 to 18.000 kJ/kg.

The choice of arched sieves for coal slime classification resulted from its specific properties. Tangential application of thin layer (film) of water-slime slurry onto surface curve of mesh sieve triggers reduction of active space of sieve mesh s and raise of centrifugal forces on dewatering and grain division from heavy and light. In numerous examples, a process of coal grain flotation in arched sieves is also observed.

The correlation between sieve mesh size 's' and border diameter of extracted grains 'dgr', is estimated by the following equation (product) :

$$d_{gr} = 0,5 \div 0,6 \cdot s \quad (2)$$

Regarding that the borderlines between coal fractions and loam fractions are close to the limit of grain diameter, which is 0,05 mm on average, it means that the most relevant is arched sieve with mesh size of 0,1 mm.

At first, all research on fine grain coal waste slurry dissolution were carried out on sieves with mesh size of 1 mm, which corresponded to grain limit of 0,5 mm, which did not guarantee full coal concentrates emission. An improvement on coal concentrates recovery was observed with sieves with mesh size of 0,35 and 0,1 mm. Partial collection of dissolution results on arched sieves are shown in table 3.

The most comprehensive coal concentrates emission was obtained on arched sieve with mesh size of 0,1 mm – table 3. There were studied three

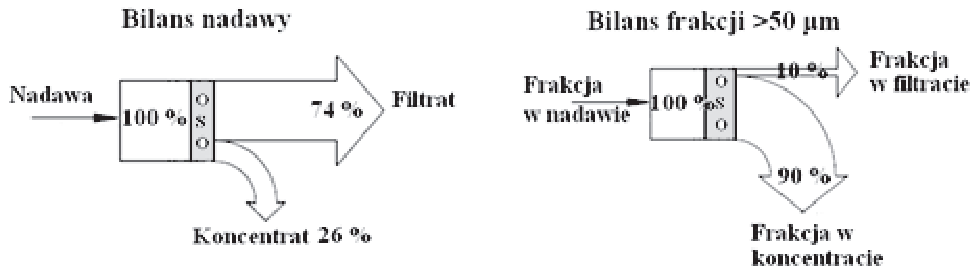

Fig. 5. Mass balance of feed and >50 µm fraction

Rys. 5. Bilans masy nadawy i klasy >50 µm

water-slime slurries derived from slime cakes, which varied with grain fraction content + 0,063 mm, and by this coal concentrates of high heat combustion value (18,6; 20,3 and 27,1 MJ/kg) were acquired, with adequate recovery volume of 25; 17,7 and 13,7% of the feed.

All these experiments with arched sieves have been used to elaborate new approach for industrial in-stallation. Traditional arched sieves have been substituted with dewatering centrifugal sieves (the so-called OSO sieves) to improve the process of quantitative emission of coal concentrates and to increase capacity of sieves (calculated as m^3/m^2). It was especially essential, as the production company Progress Eco SA has developed production of wear-resisting sieves with mesh size of 0,1 mm – figure 3. OSO sieves are features with high efficiency of grain distribution and higher efficiency per unit (m^3/m^2), due to action of higher centrifugal force.

This solution is also supported by industrial experiments with the use of OSO sieves applied for de-watering of culm and slimes in mining industry and its application for separation of bottom ash from fly-ing ash from water slurries and water purification from water-bottom ash circulations [8, 2, 7, 6].

Pilot installation, with industral sieve of diameter of 1200 mm, was constructed in order to verify as-sumptions regarding separation and selection of grain fractions with granulation over 0,05 mm with the use of OSO sieves with mesh size of 0,1 mm. The OSO sieves were also used to test efficiency and con-ditions of separation and emission of grain fractions over 0,05 mm.

The aforementioned research and trials, in comparable conditions, enabled us to conclude the follow-ing:

1. OSO sieve with mesh size of 0,1 mm and diameter of 1200 mm, in standard construction, offers fil-tering surface of 2,3 m^2, whereas in the case of upgraded sieve it is 2,8 m^2.

2. Unit capacity of the upgraded sieve equals 14,3 m^3/m^2 with feed processing in the volume of 40m^3/h and 11,8 m^3/m^2 with feed processing with the volume of 33 m^3/h;

3. OSO sieve capacity during gravitational feed input, to high degree, depends on hydrostatic feed pressure and the degree of throttle opening in pipelines providing the feed. After the change of pressure height of slurry onto the sieve in the range from 0,96 m to 1,8 m and the degree of throttle opening from 22 to 100%, the OSO device efficiency increased from 14 to 39 m^3/h;

4. The construction and method of installation of the nozzle providing feed onto the sieve wheel have great impact on capacity and quality of feed processing. The task of nozzle is not only to provide the feed but, most importantly, to provide kinetic energy ensuring circulation of the feed on sieves of the wheel, shelf and cone – figure 4.

5. The volume of selected grain fraction over 0,05 mm (of concentrate) for 100 µm constituted aver-agely 24% of the fees, which is demonstrated on mass balance in figure 5.

Conclusion

The possibilities to improve calorific properties of fine grain coal waste for power engineering have been confirmed by the conducted research and trials and partially by incorporations on industrial scale.

The decrease in water content in fine grain waste can be achieved through the selection of appropriate filters and dewatering centrifuges, as well as with feed granulation and ionic surfactant. Especially effi-cient method of dewatering and acquiring new structure of coal slimes is their granulation with addition of active agents of calcium.

The best method to increase fine grain coal waste energy value is their selective extraction from the courses of the chosen technological nodes from the water-slime circulation and their grain classification in devices ensuring extraction of grain fraction over 50 μm. From the all analysed and verified grain classi-fication method in pilot installations, the most efficient and at the same time the simplest solution ap-peared to be application of dewatering centrifugal sieve with mesh size of 0,1 mm.

Fine-grained coal wastes in the form of cakes and/or deposits from settlings are only partially used as independent fuel or as a supplement to basic fuels, whereas the rest most often constitutes waste landed into environment. High content of ash and water in fine grained coal wastes is not advantageous for its rational use as fuels (low calorific value, increase of CO_2 emission).

The research carried out on numerous fine grained coal wastes from current production and settlings has shown substantial differences in composition and properties of coal slimes and postflotation wastes. In the case of coal slimes we observe relatively acute separation of mineral part (loam) from coal maceral part in relation to its grain composition. The research conducted on postflotation wastes does not report analogous relationship.

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Wykorzystanie drobnouziarnionych odpadów weglowych

Najczęstszym rozwiązaniem w zakresie gospodarki wodno-mułowej w zakładach wzbogacania węgla jest łączenie strumieni z poszczególnych węzłów technologicznych w jeden strumień zawiesiny. Efek-tem tych rozwiązań jest mieszanina fazy stałej i ciekłej o uśrednionym składzie i właściwościach fizy-kochemicznych.
W zależności od zastosowanych metod odwadniania szlamu, otrzymujemy mieszaniny o zróznicowa-nym składzie.
Spośród badanych metod odzysku wegla z zawisin wodno- mułowych najciekawsze wyniki o znacze-niu przemysłowym uzyskano dla procesów odwadnianai na przegrodach filtracyjnych. Wprowadzenie do praktyki przemysłowej sit łukowych i odśrodkowych sit odwadniających (tzw OSO) o minimalnym rozmiarze oczek sita , umożliwia odzysk węgla koncentraty z zawisin wodno-mułowych. Odzysk wę-gla z odpadów flotacyjnych jest trudniejsze, a najczęściej najlepsze efekty uzyskuje się przez zastoso-wanie procesów flotacji.
Przeprowadzone badania drobnouziarnonych odpadów węglowych pozwoliły na opracowanie nowych technologii i ich wdrożenie w przemyśle.

Słowa kluczowe: muły węglowe, flotacja odpadów, drobnouziarnione odpady węglowe, podwyż-szenia wartości opałowej