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Part 3

ASH AND SLAG HANDLING

3.2. Ash and slag handling systems at TPPs

3.2.3. Bottom ash/slag removal

3.2.3.3. Segregation, classification and dewatering of slag and bottom ash

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ABSTRACT

The purpose of dewatering and classification of slag from hard coal combustion is the elimination of slag hydro-transport to disposal lagoons thus reducing water consumption as well as costs of hydro-transport and storage of water-slag or water-ash-slag suspension and of slag aggregates' production. The developed technology is based on application of centrifugal sieves, enabling not only slag dewatering but also its classification and removal of remaining bottom ash and cenospheres.

The application of centrifugal sieves of OSO type results from their individual effectiveness and high efficiency; the sieves make use of not only gravity force but also centrifugal force and flotation effect. The effectiveness of the sieves was confirmed in the process of dewatering flotation concentrates and coal tailings, de-silting sands as well as in three power stations producing slag aggregate.

INTRODUCTION

Aggregates obtained from stoker fired and pulverized-coal boilers' slag can be characterized by good construction and insulation properties, and that is why they are used in construction industry and engineering works. Many a time, the lack of simple and inexpensive technologies of slag separation and classification from water-slag and water-ash-slag suspensions is in the way of their mass use.

In recent years, a new problem arose, namely, in power stations with hydro ash removal system, making use of dry fly-ash, the transport of the remaining slag to a disposal lagoon is not rational due to hydro-transport costs, water consumption and slag disposal in the lagoon. In a few power stations there were built settling tanks for collecting water-slag suspension, where the collected slag is at the same time (gravitationally) dewatered.

One can also come across the solution of using flat sieves system. In most cases the control of segregated slag graining and its refining (removal of ash, water soluble components etc.), is not possible.

Solution to the above problems can be guaranteed by a technology based on application of OSO centrifugal sieves, making use of centrifugal forces and gravitation as well as flotation effect and classification. The developed technology and acquired results have been exhaustively described in a number of papers and technical documentations [1-4].

1. CHARACTERISTICS OF CENTRIFUGAL DEWATERING SIEVES

Centrifugal dewatering sieves (OSO), had been known since 1960-ies. They had been generally used in the coal processing industry in both Poland and abroad. Centrifugal dewatering sieves belong to a group of static processing devices for dewatering, dislodging and classification of fine fractions of fine coals, coal tailings, and sands.

The process consists in feeding the materials through nozzle outbox in a rotary motion onto the surface of conical sieve baskets – figure 1. Dewatering of the feed material is caused by centrifugal forces and gravitation, whereas screen classification depends on the selection of a conical sieve basket. The sieve works without the use of electric energy; it does not produce any noise and does not require routine maintenance.

A common unit for all kinds of OSO sieves is a sieve basket whose upper part is collar-shaped and the lower one forms a conus. The whole of the sieve construction is based on metal framework forming a basket, the segments of which are permanently filled with metal or polyurethane. Metal conical baskets in slotted version are constructed from welded or looped profile wire. This series of sieve types includes the following sizes: 1200, 1600, 2000, 2400, 2800 and 3200 (conical sieve diameter); their characteristics are presented in table 1.

The characteristics presented in table 1 above indicate that there are possibilities of solving slag problems for big and small power stations, CHP plants and heat-generating plants. The choice of slot depends on the required classification of feed material and it is assumed that the diameter of segregated grain can be determined as follows:

$$s = (0{,}5 \ldots 0{,}6) \cdot d$$

where: s – slot, mm, d – diameter of grain segregated on the OSO sieve, mm.

While working with slag, it is recommended that welded slot sieves be used; they can be characterized as follows:

- ability to convey heavy loads;
- high coefficient of open space;
- low susceptibility to soiling;
- ideally flat and smooth surface,
- high precision of workmanship;
- increased effectiveness and accuracy of separation and dewatering.

OSO construction complies also with the requirements for modern installations, as it is simple to make, easy to mount and transport and there is no problem with its operation and repairs.

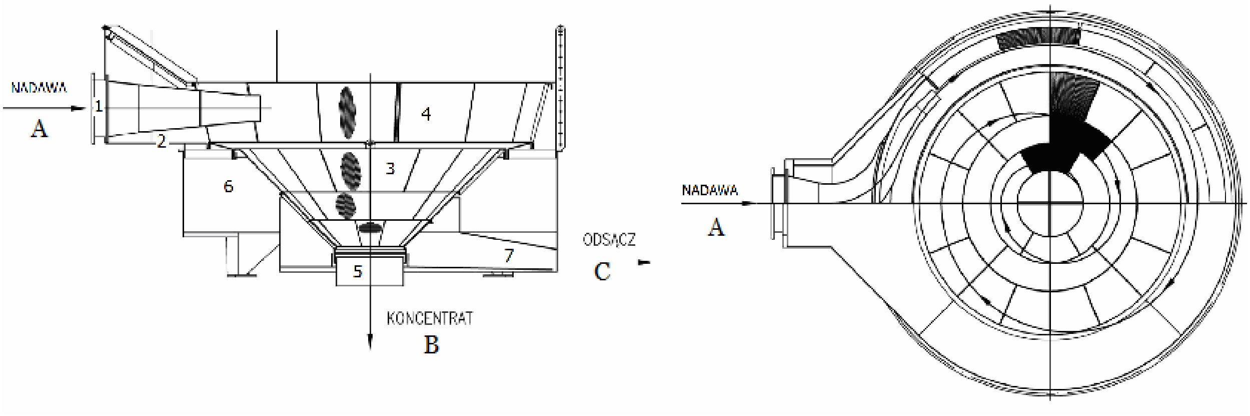

Fig. 1. Centrifugal dewatering sieve-OSO: A – feed material: B –concentrate; C –drain-off; 1 –nozzle outbox; 2 –steering wheel casing; 3 – conical sieve basket; 4 –steering wheel ; 5 –dewatered product exit; 6 –drain-off cumulative vessel; 7 – drain-off exitumption.

Table 1. **Characteristics of the OSO sieves type B (with sieve basket in steering casing)**

OSO sieve size		1200	1600	2000	2400	2800	3200
Basket working surface	m²	1,4	2,6	4,1	6,0	8,3	10,5
Wheel working surface	m²	0,9	1,6	2,7	4,0	5,1	5,6
Sieve slot	mm	To be selected by a customer					
Weight	kg	1180	1810	2400	2770	3900	4000
Approximate efficiency for a slot s = 0,75 mm	m³/h	230	420	680	1000	1340	1650

2. SEPARATION AND DEWATERING OF SLAG AND PRODUCTION OF AGGREGATES

There were built three installations for separation of aggregate complying with the standard for elporyt aggregate. Two installations were built on wet disposal lagoons, at the dump of water-ash-slag pulp, and one in the region of a boiler-house, on water-slag pulp. The slag falling out of a wet slag trap was crushed down to the size of 10…20 mm and then hydraulically conveyed to ash removal pumping station - fig.2. In the above cases, from slag with 17…26 % loss on ignition, there was obtained an aggregate fraction of 2,8…4,7 % ignition loss.

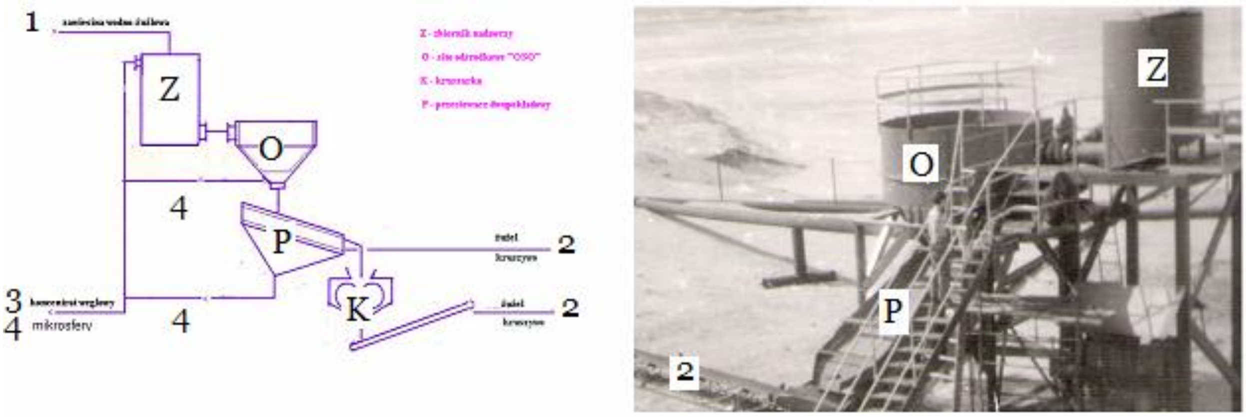

Fig. 2: A diagram of slag separation and dewatering and a picture of elporyt aggregate production system: 1 – feed material; 2 – slag/aggregate; 3 – coal concentrate + cenospheres; 4 – drain-off; Z – feeding tank; O – centrifugal sieve; P – screen; K - crusher

Eluate containing unburned coal and grains below 3mm flowed gravitationally to ash removal system.
The mounted sieving installation was to separate fractions of aggregate and dewater it. At that time little importance was attached to coal recovery, therefore coal concentrate with ash was dumped at a storage yard. Currently, there are chances of preparing an installation for separation and dewatering of furnace slag for production of slag aggregate with a possibility of separation of coal concentrates and cenospheres - figure 3. The separated coal concentrate, after dewatering, can be

returned to renewed combustion, by adding it to fuel at dumping ground or in a bunker.

The solutions mentioned above, allow to eliminate expensive and troublesome systems of hydraulic transport and storage of slag. In many instances the installations can be mounted in the vicinity of boilers thus enabling direct receipt of dewatered slag (drip humidity), as well as a possible recovery of coal and cenospherical concentrates, transferred to settling tanks or directly separated in hydro-cyclones, with a full return of eluate to hydraulic slag traps or pumping stations.

The basic condition for making a decision on the use of OSO for dewatering and recovery of combustion by-products is:

1. knowledge of physical-chemical properties of slag and/or fly ashes and/or ash and slag mixtures;
2. defining the purpose of using the solution under discussion;
3. developing a technology for dewatering and recovery of combustion by-products suitable for local conditions;
4. providing simple and easy service and maintenance for the installation with OSO sieves.

Basing on vast experience gathered in mining industry and at pilot installations in power stations it can be said that that there are conditions for mounting ***an installation*** for slag separation and dewatering which would be ***not only cheap*** but also ***simple and easy for operation, maintenance and repairs.***

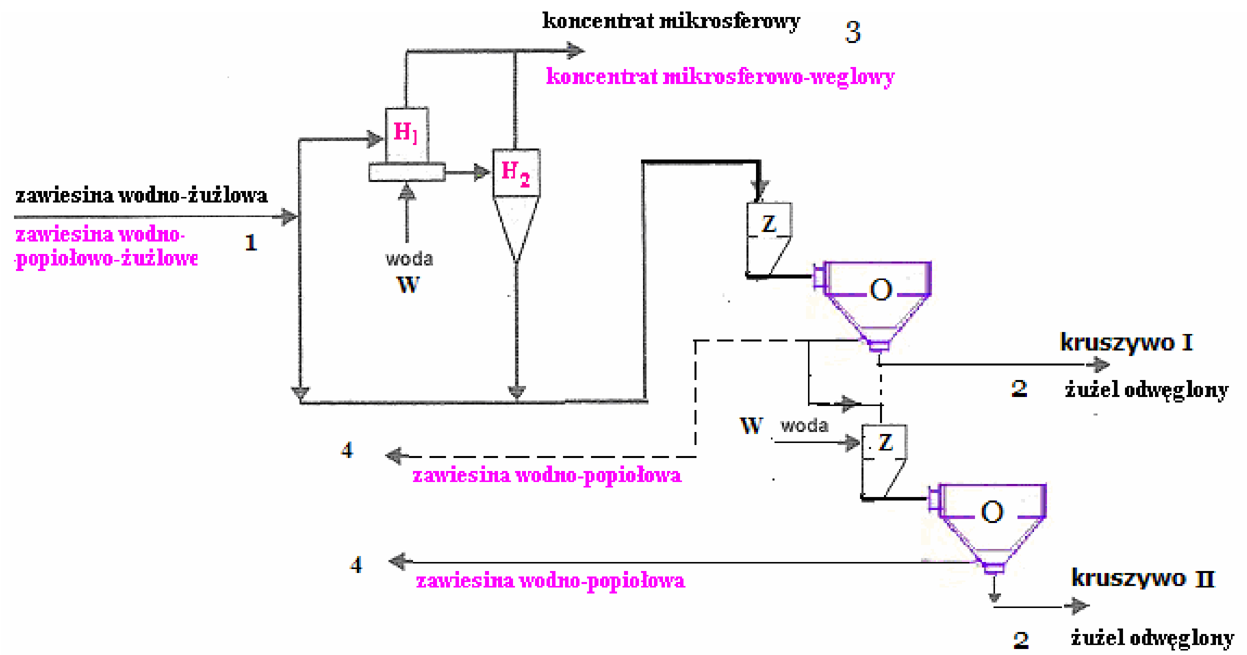

Fig. 3. Production of slag aggregates, coal concentrates, and cenospheres – a diagram
1 – feed material; 2 – slag/aggregate; 3 – coal concentrate+ cenospheres; 4 – drain-off; Z – feeding tank; O – centrifugal sieve; P – screen; H – hydro-cyclone; W – water.

So far, the experience has shown, that the use of OSO centrifugal dewatering sieves for separation and dewatering of slag from water-slag and water-ash-slag pulp, with small capital expenditure, enables not only to lower the costs of storage management of waste – slag, but also to put it to use as a building aggregate etc.

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