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A SYSTEMATIC OF CLEANING MACHINES IN THE MINERAL PROCESSING INDUSTRY

Рассматриваются очистные установки для обогащения полезных ископаемых. Процесс очистки подразделяется на два субпроцесса – растворения и сепарации. На основе анализа принципов работы и результатов для каждого из процессов выбраны типы оборудования. Для достижения большей ясности и использования результатов использованы каталоги конструкций.

Cleaning machines for mineral processing of raw materials are regarded in the article. The cleaning process is divided into the two sub processes: dissolving and separation. Machine types are assigned to these processes and systematized on the basis of the effects and operational principles analysis. In order to reach better clarity and management of the results, construction catalogues were used.

The mining process of mineral raw materials (Sand, Gravel, Ore) produces a lot of waste materials or foreign substances. This cannot be avoided because of the genesis of the deposit or the mining technology. One of the purpose of the mineral processing is to eliminate the waste materials out of the raw material. In this case washing and concentration processes are very important for this process. In the following article it will be tried to structure and systematise the big group of cleaning machines.

In general a cleaning machine is used to separate waste materials from raw materials. Depending of the bond properties of the waste materials, different types of dissolving and/or separating processes are necessary. Both process steps could be realised in one machine or in separated machines. The cleaning process can be divided into two process steps, like it's shown in fig.1. The first is the dissolving process and the second the separating process. The application of the process steps depends on the handled materials. The dissolving process could be separated in different sub processes. Selective crushing is used to dissolve disseminations of different crushable materials, without breaking the resource.

The process stage of dispersing describes all release processes in cleaning machines, with which the pollutant is dispersed and/or suspended by mechanical energy entry in a solvent (usually water). The grinding process covers all processes

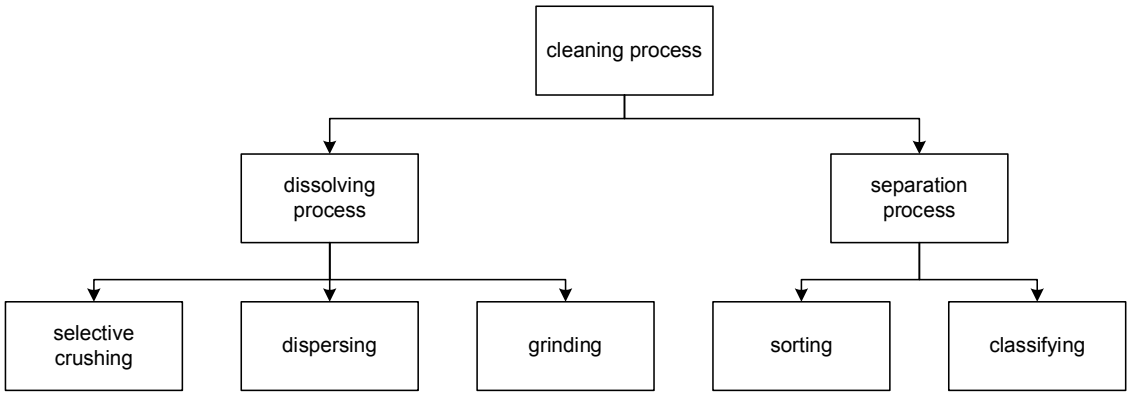


Fig.1. Classification of the cleaning process

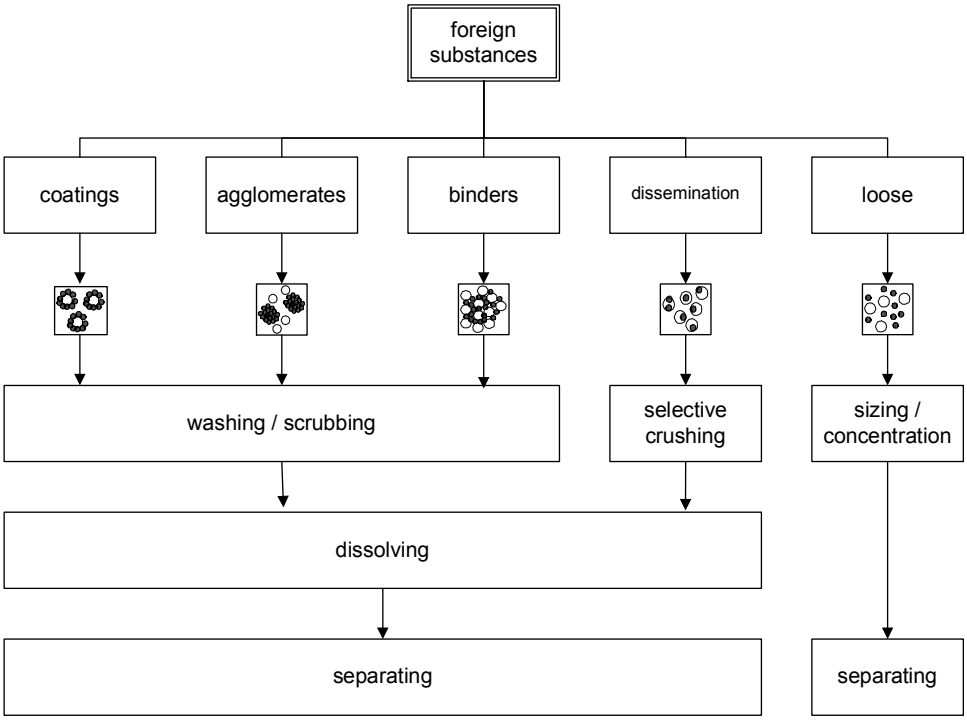


Fig.2. Pollutant connections and their purification process

in those agglomerates could be dissolved by using mechanical or thermal energy. The separation process contains the process steps concentration and sizing. Concentration takes place with priority after gravimetric characteristics and sizing by geometrical characteristics.

Depending of the kind of raw material which can be prepared, differs the kind of the pollutants containing in it.

In the sand and the gravel industry, all fine fraction < 63 μm (tone, silt) and organic components (wood, coal, peat) must be separated. Within the range of the ore preparation the main problem is finenesses. The choice of the cleaning machine is determined primarily by the kind of connection of the pollutants as well as their physical characteristics. Finenesses can be present as agglomerates, incrustations or as bonding agents between the valuable materials. The connections between the particles are based here particularly on capillary and adhesive powers. Dissolving these binding forces alone by water is usually not sufficiently; only by a mechanical energy entry can a sufficient desintegration of the connections take place.

Organic components occur generally freely in the raw material and separating under the utilization of the different physical characteristics is sufficient. In fig.2 the pollutants and their possible connection forms are specified in the raw materials. The process steps necessary for the separation are assigned these. Coats, agglomerates and pollutants as bonding agents are grinded by wash processes and will be dispersed in water, afterwards take place the separation of the pollutants via sizing or concentration processes. Loose available pollutants must in the course of the dressing not be unlocked, but can directly by appropriate processes be separated.

As cleaning machines, all machines to dissolve and to separate pollutants are regarded. Depending of the task, different machines are used in the preparation technology. To remove of finenesses out of sand and gravel come high pressure washers, log washer, wash drums, washing screws or bucket wheels to the employment. For separation of organic components log washer with upcurrent nozzles, hydrosizer, or jigs can be used depending upon configuration. In order to be able to systematize those differently aggregates, it must be tried to find common basic functions. Usually it offers itself to represent the cleaning machine in their general

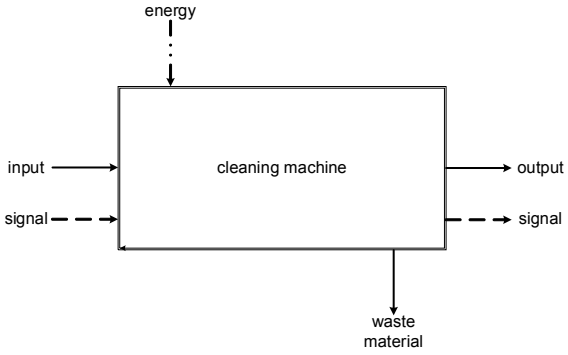


Fig.3. Black box of a cleaning machine

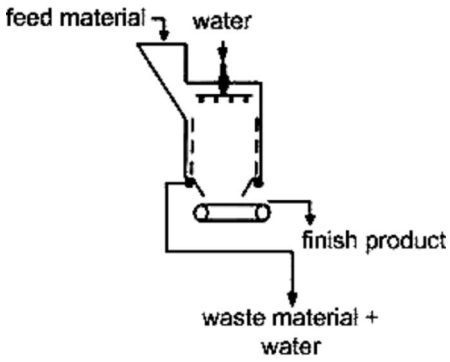


Fig.4. Principle sketch high pressure washer

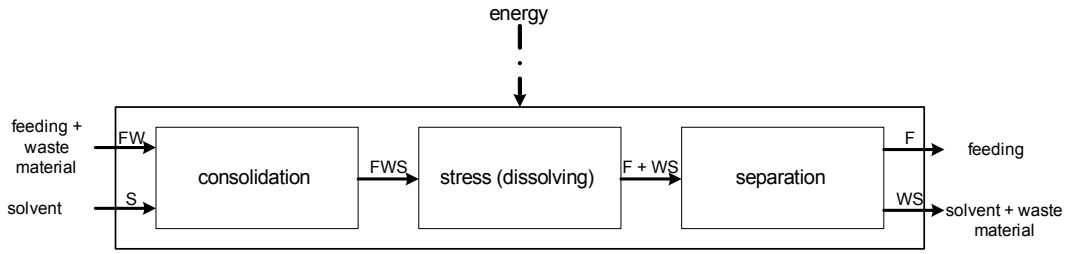


Fig.5. Extended function structure high pressure jet scrubbers

form as a black box with the initial and output values (fig.3). From this model different function structures for the different machines can be developed.

Koller defined ten different material operations for the development of function structures such as changing, leading, releasing, mixing, separation, collecting or dividing. These functions are elementary unit operations and refer to physical effects. [1, 2] Out of this for each machine a function structure is developed.

In fig.4 the principle sketch of a high pressure washer is represented. The feed material (valuable material and pollutant) is given up over a inlet hopper. The solvent water is supplied to the process area through a rotor as high-pressure water jets, it serves at the same time as demand organ for the feedings. The pollutant dispersed in the water is delivered by laterally arranged sieve inserts. The function structure resulting for this procedure is represented in fig.5. The feedings are united in the process area with the solvent, stressed at the same time and separated afterwards. This proceeding is also used for the other types of machines and an extended function structure is set up. It turned out that the cleaning machines can be divided altogether in three groups. The first group contains «dissolving» cleaning machines, without separation function. In the machines of the second group both processes run off, here will be dissolved and separated. The third group serves only for the separation of the pollutants. The machines of the second group are aligned primarily to the dissolving of the pollutants, the separation process run off with most of these machines only insufficiently, so that after these machines separating cleaning machines are necessary. Therefore this group is assigned to the first group, in order to achieve an improved clarity at the same time.

In order to obtain process intensification, some authors suggest refraining from process integration and instead use dissolving and separation process in different aggregates. [3]

After the machines were divided in two groups, its necessary to partition the different machines inside of the groups. A characteristic for distinction is the form of the energy entry, which can take place mechanically, hydraulically (in the form of water), electrically or in the form of thermal energy. The mechanical

part of arrangement				
main process	*micro process*	*energy input*	*principle of action*	*action orga*

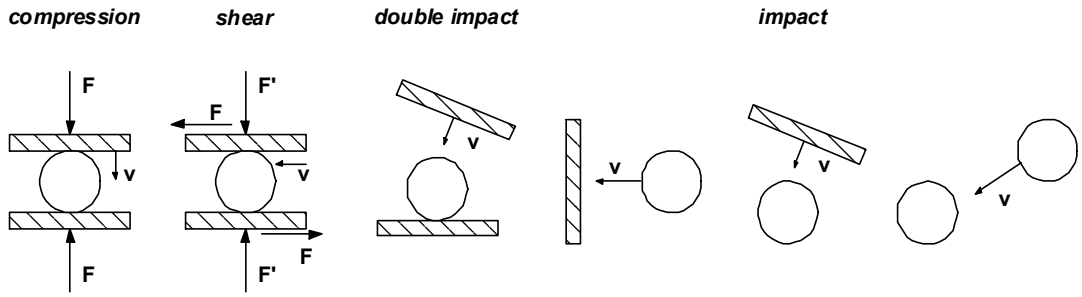


Fig.6. Kinds of demand

energy entry finds in the majority of the machines application. The input of thermal energy represents a special case, with which the feed material in a drum dryer is dried. The fine materials disintegrate itself and can be screened from the value material. A further partitioning can be made by the kind of the demand of the feedings. In fig.6 the relevant kinds of demand are represented. These were assigned to the individual machine types. In some cases appears in the machines a combination of different kinds of demand. This was considered in the allocation.

As a last arrangement characteristic, the kind of the demand organ was selected. The demand organs affect the stress intensity of the feedings as well as the wear which can be expected with its different form and geometry. The organization and arrangement of the dissolving cleaning machines are represented in form of a construction catalogue in fig.7.

Consisting of an arrangement part, with the differentiating factors specified above, and a main part this catalogue makes possible an overview of the entire machines. The separation process could be divide in sizing or concentration processes. Sizing processes have the geometrical characteristic of the particles (grain size) as separation characteristic. Concentration processes can use the most different physical characteristics of the materials, here particularly according to the density are sorted. Other physical characteristics like the susceptibility, colour or the elastic material behaviour are used only in some special tasks. In many cases the machines use both sizing processes and concentration processes, in order to separate the pollutants. That's why a clear allocation to certain separation processes is made more difficult. Therefore an allocation to the further separation characteristics took place in access part.

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