

Optical Sorting of Ceramic Raw Material



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Abstract

Optical sorting systems have proven their effectiveness regarding the sorting of minerals in recent years. They are able to separate raw material by their colour, shape or brightness at low costs and as such replace selective mining or manual picking. Also, in particle size ranges <40 mm, where manual picking was not eco-

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nomical, up to particle sizes of 3–5 mm, optical sorting plants can relieve existing processing technologies or even replace them. This development allows separating raw materials to optimal particle sizes and as such natural resources may be used more effectively.

Keywords: optical sorting of minerals, raw materials, preparation

1 Introduction

In order to produce ceramic products at low cost with constant good qualities, production processes must be optimised and, most of all, standardised. Therefore, the ceramic industry demands high quality, standardised products in order to be independent of the original raw material. Suppliers of industrial minerals must guarantee continuously higher qualities and comply with constantly demanding product specifications. These demands can only be met by an optimised and economic processing of the raw material. As "pure" raw material is very rare, the processing of raw material compounds is highly important. Classical processing technologies separate materials by their physical or chemical characteristics, e.g. by flotation, various density separation processes, magnetic and/or electro-static segregation or by disconnecting and precipitation. Also, separation by colour is known for quite some time. For example, only certain qualities are selected for processing in the deposit. Generally, the min-

er decides on this subjectively. Furthermore, materials may be separated manually, given a certain size. Both these jobs can be done by modern optical sorting systems that are able to separate most different materials effectively, i.e. automatically. The Mogensen sorting system MikroSort® has proven to be a reliable sorting system for years, even under adverse conditions as can be found in mining, e.g. sorting of baryte [1] or feldspar [2].

2 Optical Sorting

2.1 Construction and Operation of the Mogensen Sorters

The vibratory feeder ensures that the material arrives in an even, single-particle layer on a chute (Fig. 1). Here, the material accelerates and is "scanned" in free fall by one or several high-resolution colour line scan cameras covering a width of 1200 mm. A parallel computer evaluates these scanned pictures. According to this evaluation, compressed air valves are controlled within milliseconds, which eject an undesired particle from the material flow.

2.2 Sorting Stipulation

This principle works under the condition of particle sizes of 3 to 250 mm.

- The materials to be separated must be clearly different in colour or brightness. Even small colour differences are sufficient, a certain conditioning of the material is pre-assumed. This means, however, that dirty mineral has to be washed.
- The material is fed in narrow size ranges. Accordingly, sorting parameter or air pressure may be adjusted to the respective fraction.
- It must be possible to single the material.

2.3 Limitations of Sorting

The efficiency required depends on the average particle size and the quantity of particles to be rejected. A fraction of 3–5 mm may be sorted with capability of

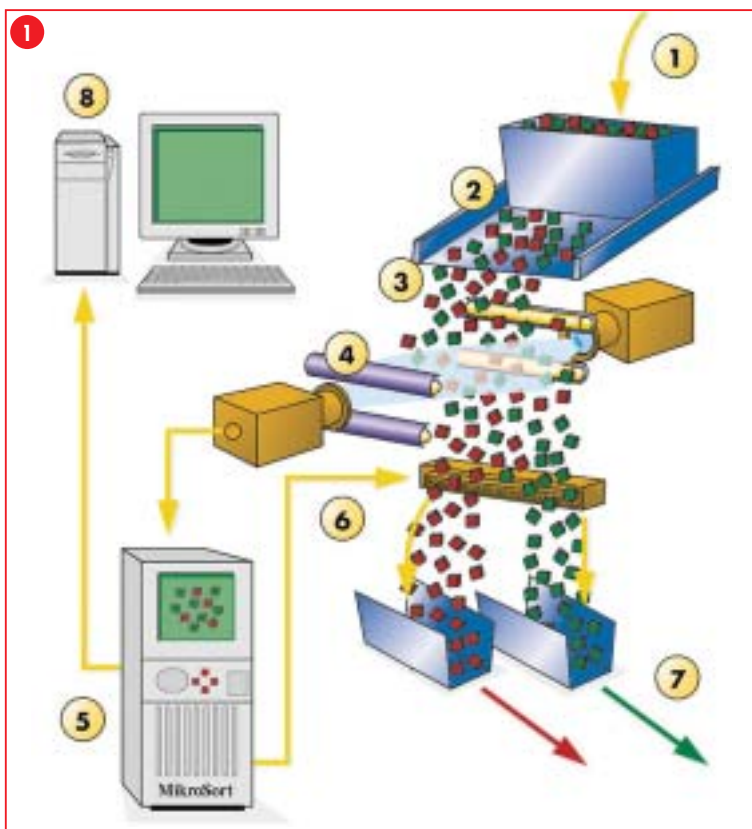


Fig. 1
Principle of optical sorting: 1) material feed into hopper, 2) singling on integrated vibratory feeder, 3) conveyance into free fall, 4) scanning of the "product curtain" by high-resolution optical sensor system, 5) image evaluation by rapid parallel processor technology, 6) product selection by means of high-accuracy compressed air impulses, 7) removal of separated product streams, 8) field bus network interface to central control

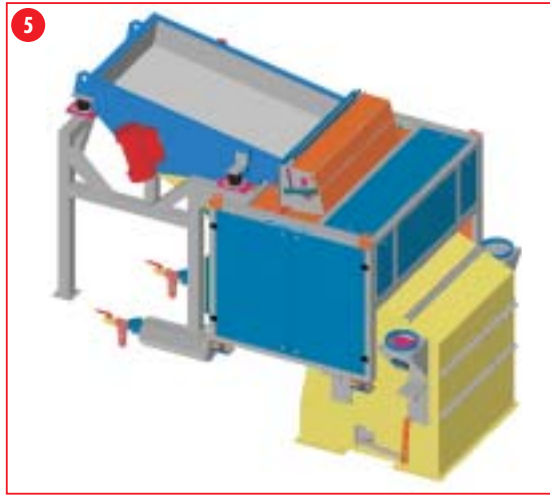
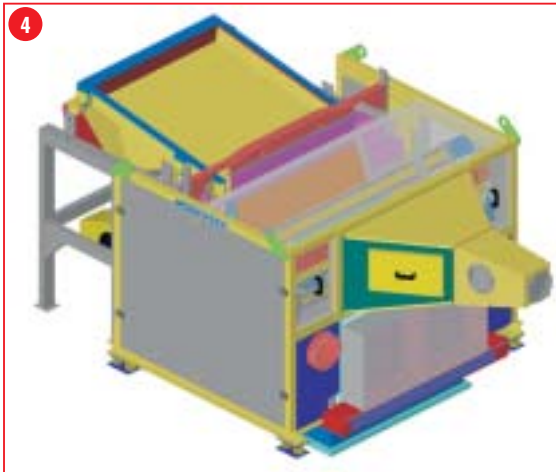
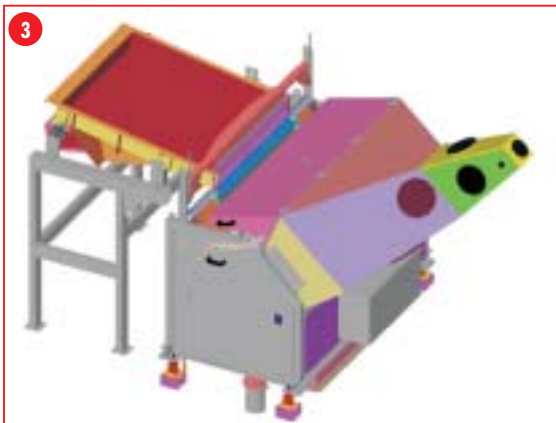


Fig. 2
MikroSort® AF

Fig. 3
MikroSort® AP

Fig. 4
MikroSort® AS/AT

Fig. 5
MikroSort® AG/AH



3 Examples of Sorting

There are various reasons for separating materials. Figs. 6a–7c show sorting of feldspar and/or wollastonite. Here, the quality of the product is improved by the sorting. By rejecting the yellow, red and dark particles, the white grade is improved and/or the iron content reduced. A higher profitability is achieved by sorting the material.

Figs. 8 a–c show sorting of burnt magnesium oxide. In the burning process, not all materials are burnt. These mixed fractions are added again to the burning process. By sorting the burnt parts, the effectiveness and the productivity of the burning process is increased.

Figs. 9 a–c show sorting of magnesite. So far, sorting was possible only from 12 mm and more and consequently, millions of tons of fine material was piled-up. With the Mogensen sorting machine it is possible to process this piled-up material economically. Further, successful sorting processes have been carried out with the following products: improvement of white grade of raw clay, separation of high-quality refractory bricks, elimination of ferrous impurities in andalusite, white-grade improvement of cristobalite and separating feldspar-quartz mixtures.

4 Evaluation and Outlook

With optical sorting, new possibilities are at hand to process raw material at low cost. This new technique has proved true under the hardest conditions and guarantees stable results during continuous operation. It may, in many areas, relieve or even replace costly and unduly environmentally intensive processes. As the effi-

5 t/h, if only a small quantity has to be rejected. An increase of the quantity to be rejected to 30 %, reduces the possible capability to below 2 t/h. The sorting of fractions between 100–250 mm achieves performances of 150–200 t/h.

2.4 Machine Types

A consequent development of their sorting machines (Figs. 2–5) enables Mogensen GmbH & Co. KG (Germany) to offer a variety of machine types which guarantee optimal results in the size ranges 1–10 mm, 5–40 mm, 30–80 mm and 50–250 mm. The sorting machines are individually equipped with different types of valves, optimised for the respective size range (Table 1).

Machine types	Width / mm	Valves / pcs	Particle size range, typical / mm	Sorting capability / t/h
MikroSort® AF	900	220	1–10	0.5–10
MikroSort® AP	1200	256	5–40	5–30
MikroSort® AS/AT *	1200	220	30–80	30–90
MikroSort® AG/AH *	1200	256	80–250	70–200

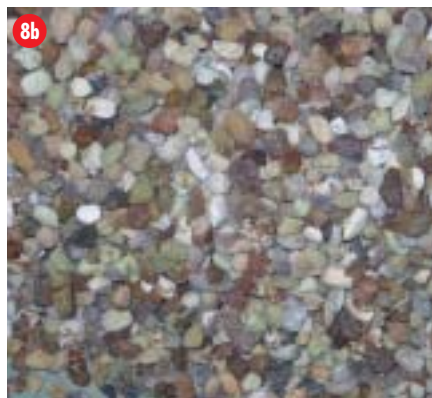
* a second camera can be mounted on this MikroSort® machine in order to view particles from two sides



Figs. 6 a-c
 Sorting of feldspar 15-40 mm, capacity: 30 t/h, reject quantity approx. 40 %



Figs. 7 a-c
 Sorting of wollastonite 8-20 mm, capacity: 20 t/h, reject quantity approx. 40 %



Figs. 8 a-c
 Sorting of burnt magnesium oxide 10-30 mm, capacity: 25 t/h, reject quantity approx. 30 %



Figs. 9 a-c
 Sorting of burnt magnesium oxide 8-12 mm, capacity: 20 t/h, reject quantity approx. 40 %

ciency of computers, camera- and other sensor-systems is constantly developing, an end to the development is not in sight. In the future, the scope of optical sorting will grow to an extent which today is still unthinkable. The efficiency of separation with air pressure and the consequent profitability of a sorting process are the only limits.

References

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Kurzfassung/Résumé/Resumen

Optische Sortierung von keramischen Rohstoffen

Optische Sortieranlagen haben in den vergangenen Jahren ihre Effektivität in der Sortierung von Mineralien unter Beweis gestellt. Sie sind in der Lage, kostengünstig Rohstoffe aufgrund ihrer Farbe, Form oder Helligkeit zu trennen und können dadurch einen selektiven Abbau der Lagerstätten oder händisches Klauben am Leseband ersetzen. Auch in Kornbereichen <40 mm, in denen händisches Klauben nicht wirtschaftlich war, bis hin zu Korngrößen von 3–5 mm, können optische Sortieranlagen bestehende Aufbereitungsprozesse entlasten oder sogar ersetzen. Diese Entwicklung ermöglicht es neuerdings, Rohstoffe in ihrer für den Aufschluss optimalen Korngröße zu separieren und hat zur Folge, dass natürliche Ressourcen in bisher unbekannter Weise effektiv genutzt werden können.

Tri optique des matières premières céramiques

Ces dernières années, les systèmes de tri optique ont démontré leur efficacité pour le tri des minéraux. Ils sont capables de séparer les matières premières par couleur, forme et éclat, ceci pour un bas coût et avec possibilité de remplacement des opérations sélective de mine ou de tri manuel. En outre, pour les tailles de particules inférieures à 40 mm, pour lesquelles le tri manuel n'est pas économique, jusqu'à des tailles de 3–5 mm, les dispositifs de tri optique peuvent suppléer les technologies actuellement mises en oeuvre, voire les remplacer. Ce développement permet la séparation des matières premières jusqu'à la taille de particule optimale, et donc une gestion plus efficace des ressources naturelles.

Clasificación óptica de materias primas

Recientemente, los sistemas de clasificación óptica han demostrado su efectividad para clasificar minerales. Estos sistemas son capaces de separar materias primas según su color, su forma o su blancura, reemplazando la extracción selectiva o el clasificado manual. Asimismo, para tamaños de partícula inferiores a 40 mm, para los que el clasificado manual no es económico, hasta tamaños de 3–5 mm, las instalaciones de clasificación óptica pueden complementar tecnologías de proceso existentes o incluso reemplazarlas. Esta tecnología es capaz de separar materias primas según el tamaño óptimo de partícula, ayudando a utilizar en forma más efectiva los recursos naturales.