Rejected

Optical sorting for control of limestone quality

Summary: SCHAEFER KALK GmbH & Co. KG processes limestone from a number of different quarries in the kilns of its Steeden plant. Two optical sorting machines were officially commissioned at this plant in late 2011 to permit sustainable continued operation of the quarries and to ensure constant high quality in the particle fractions for burning.

Why optical sorting?
Limestone is, as is well known, a natural product, and is thus subject to certain fluctuations in its quality and colour. Contamination with other minerals and loam at the higher quarrying levels, and also in fissures of the quarries, must also be taken into account.

Implementation
Actual conversion of limestone preparation was performed during a scheduled shutdown of only six weeks' duration. This was necessary in order to be able at all to integrate the machines into the existing process. To "core" the old system, six large scrap containers were filled during this period, a log washer was relocated, three existing belts were modified, while seven new continuous...
conveyors and two sorting units were integrated on new zinc-plated structural-steel service platforms in the existing building. A separate compressed-air system incorporating a frequency-controlled compressor and a large buffer tank, the waste-heat from which is used to supply additional heating for the building, were also installed for the two sorting machines.

The sorting machines

The two BT-Wolfgang Binder GmbH REDWAVE sorting machines can handle a throughput of 120–150 t/h of limestone, diverting out up to 30% in the process. Sorting machines such as these, with a sorting width of 2 m, are extremely rare around the world, and are used only in individual applications, such as sorting of used paper. They had not, up to this time, been used in the lime industry.

SCHAEFER KALK obtained a clear competitive advantage for itself with its innovative decision in favour of purchasing two such REDWAVE pilot systems.

Fig. 1 shows the sorting machine for feed limestone in its blue paint finish, and the trough conveyors for drying and singling located behind it. The two heavy chain curtains prevent the limestone from rolling and bouncing.

The material for sorting is scanned from two sides simultaneously during free fall across a 2 m width, with one colour camera mounted on each side. The cameras determine within a few milliseconds whether the limestone particle observed is to remain as “good” in the so-called “passes” or is to be diverted as a “bad particle” out of the material flow.

3 Colour spectrum for limestone stored in the evaluation software
and into the “rejects”. So-called “ejection” is accomplished by means of a pulse of compressed air of up to 10 bar emitted by one or more of the 250 solenoid valves installed. Four lighting arrays equipped with the latest LED technology assure correct illumination and thus true colour reproduction of the particles. Fig. 2 shows a simplified view of the function of the sorting system.

**Boundary conditions for evaluation**

The particles must be optimally pre-treated to permit their correct evaluation. They must be clean, since differentiation on colour criteria of a particle with even only a thin coating of loam from a clump of solid loam is not possible. The particles must also be moist, to permit better reproduction of colours and contrasts. Limestone particles are detected as white if they are too wet, however, due to the excessive reflection of light by the water on the surface of the particle.

**Evaluation**

We must now examine the question of what is a “good” particle, and our initial note concerning fluctuations in limestone. Fig. 3 shows the limestone colours currently stored in the evaluation software for the limestone processed at SCHAEFER KALK.

The undesirable materials also fluctuate, however, and colour overlaps in the materials to be separated can thus occur. The colours of the particles to be separated must therefore be clearly defined. Fig. 4 shows a small selection of particles to be separated.

To summarise: SCHAEFER KALK now operates two further ultra-modern machines and is thus the first company to approach the challenge of highly sensitive sorting technology in the tough service conditions encountered in a limestone preparation plant.