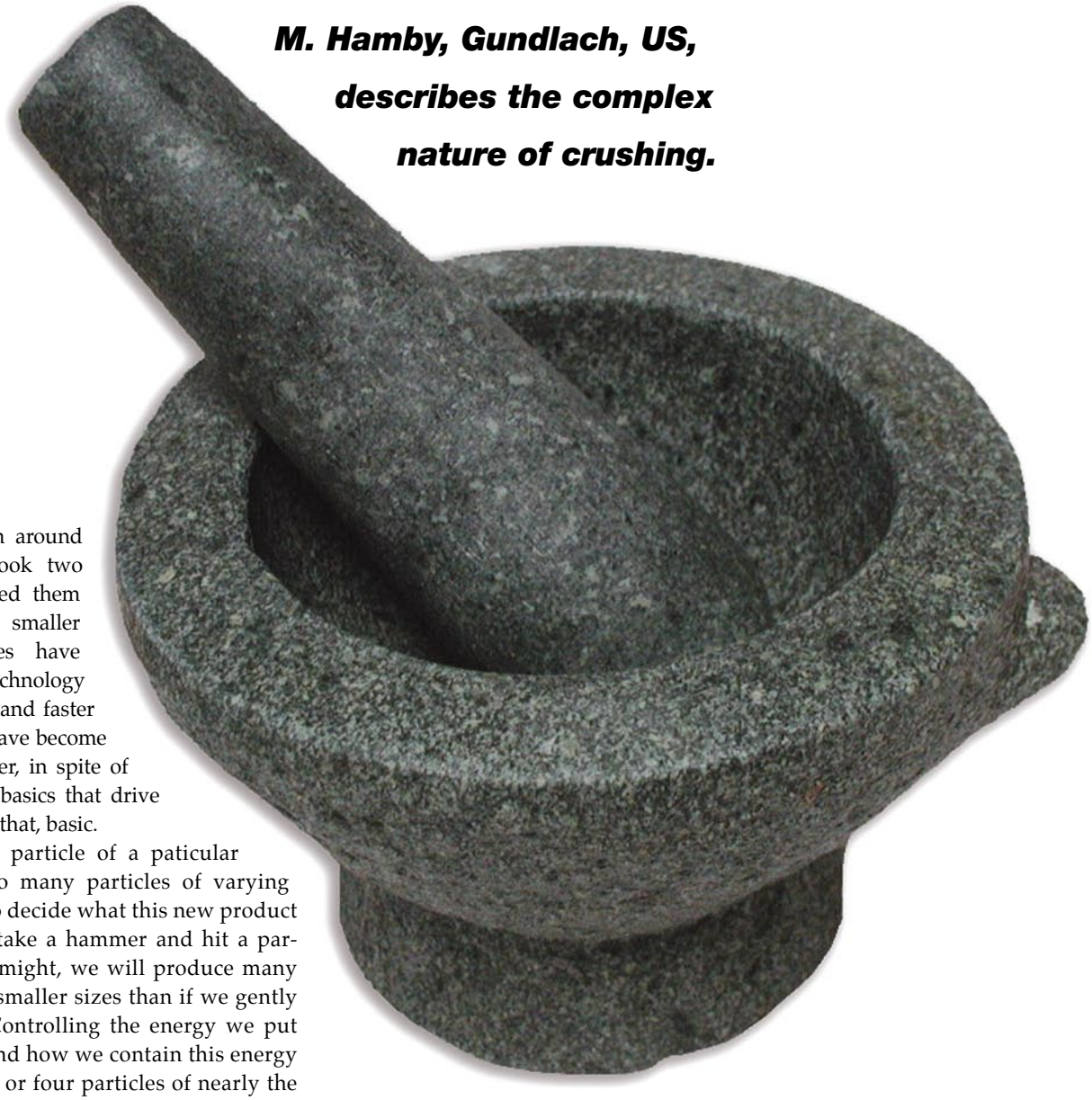
GETTING IT RIGHT

M. Hamby, Gundlach, US,

describes the complex nature of crushing.



Crushing has been around since man first took two stones and smashed them together to obtain smaller chips. The names have changed, the technology has become better and faster and the methods have become numerous. However, in spite of these changes the basics that drive the science are still that, basic.

When a single particle of a paticular size is reduced to many particles of varying sizes, one needs to decide what this new product should be. If we take a hammer and hit a particle with all our might, we will produce many more particles of smaller sizes than if we gently hit the particle. Controlling the energy we put into the particle and how we contain this energy can produce three or four particles of nearly the same size with a small amount of fine particles, whereas an uncontrolled crushing method will produce a myriad much finer particles (dust).

The person selecting the equipment to do the job at hand must decide what the entire product

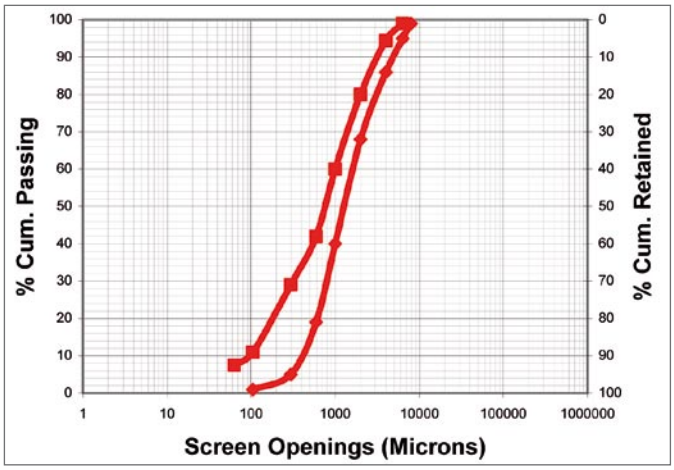


Figure 1. A sample of a 'required product'.

Figure 2. A Gundlach four roll crusher used for sizing coal and coke for fuel in

Figure 3. A Gundlach Cage-Paktor.

should be, not just the 'largest piece allowed'. This type of product can bring about many other challenges, such as wasted material. Fines may not be usable, which could create a loss of actual production. Finer particles may create downstream effects that are detrimental, be it in the handling, in environmental issues, or in the reduction of, or a lower grade of, final product.

Figure 1 depicts a minimum product and a maximum product that the process allows to be made by the crusher. The idea is for the crusher to produce this product without the aid of expensive screening and blending devices.

To obtain these select type products, Gundlach produces two basic types of equipment that exist in varying forms depending on the exact application. For particle sizing down to 10 mm (in most cases) two roll and four roll crushers, usually with timed rolls, are used for precisely controlling the percentage of product. For particle sizing below 10 mm, Gundlach produces the Cage-Paktor. For over 50 years, these crushers have created the best-controlled product with the least amount of oversize and unwanted fines.

Two roll and four roll crusher

Typical products that are required in the industry are 50 mm, 30 mm and 20 mm. Feed sizes can range from 75 or 100 mm up to 1500 mm with capacities of 50 mm product in excess of 4000 tph. These type of units have been installed to give the best product control, which means a better efficiency in the boiler and less waste material (ash). These crushers produce far less unwanted fine particles than the traditional hammer mills and impactors and can do so with a much lower connected hp. Gundlach has also replaced equipment that had been originally installed, resulting in a better product and savings of hundreds of thousands of dollars/year to the operator. The low dynamic loading of the roll crusher, along with the lower hp., made it a relatively simple change-out for the client. The Gundlach Roll Crusher (both two and four roll design) traditionally used gearboxes to time the rolls throughout its setting. By the use of the timing, as opposed to two motor drive and running the rolls at differential speed, the company has created the optimum product control and the least generation of fines. While two motor drive operation and differential speeds are used for certain materials and special applications, they are not the best when trying to control product sizing.

An additional feature of this type of equipment is the ability to adjust product sizing (within 10 - 20%) of the original product without stopping the unit. Larger product changes may require a different roll set, which can be easily changed in less than four hours. These units are also fitted with a tramp relief system, which allows uncrushable items to pass through the unit without damage. The 'instantaneous reacting' system resets to the original crushing position in a matter of one or two seconds without any operator involvement.

Other features available allow for the crushing of abrasive materials, hot materials (over 2000 °F) and wet/sticky materials.

A cage apart

While considered in the family of 'cage mills,' this exclusive design uses many features that set it apart. By introducing the material into the centre of the counter-rotating cages, it is 'gently' crushed several times, moving it to the outside of the cages as opposed to one 'big bang' crush. The material then exits the units via gravity through the bottom. No screens that can create fines and plug are used in this design. Product is totally controlled by the speed of the cages. The faster the cages turn, the finer the product. Conversely, the slower the cages turn, the coarser the product. This design lends itself very well to applications where different products are required. Simply by utilising a variable speed device (variable frequency drive, hydraulic drive, or DC type drive) with the motor, changes in speed to adjust the product control are possible while the unit continues to operate. Be it bituminous coal, sub-bituminous coal, petcoke, metcoke, lignite, or other similar materials, these can be handled in the same unit with only the speed change to be considered.

The cages use a 'flat faced' hardened replaceable striking plate, which allows

for more energy to be imparted into the crushing of the particle and less energy to be lost. This energy is used to control the final product from the unit, more closely ensuring a better product along the entire product curve. Additionally, this design has allowed the use of lower cage speeds, resulting in extended wear life and lower hp consumption.

Case history 1

The fuel specification for boiler fuel has long been a very stringent requirement. Hammer mills and impactors that had been used over the years for this requirement became the standard, though they did not produce the actual requirement. The customer then had to work around this shortcoming, thinking that there was not an alternative.

Two US east coast power plants were using the specified impactors to fulfil their fuel needs. The fines in the feed were creating enormous handling problems. Coal was sent to Gundlach's test centre and the material was tested to show that a much better fuel curve was available to the end user. After producing the curve that would both satisfy the boiler and address the material handling problem, each company purchased Gundlach equipment and easily installed it in the existing sites with minimal installation costs.

The result of these installations has been the realisation of hundreds of thousands of dollars/year in actual savings. The boiler operates quite well and the material handling nightmare of the fines has been eliminated. The final result was two efficiently operating plants.

Case history 2

A Caribbean operation was installing a new power plant. Testing was undertaken by several manufacturers of crushing equipment to provide coal products. This testing was very detailed and attended by representatives of the engineering group, as well as the end user. Gundlach's equipment (Cage-Paktor) was found to produce the best product for the boiler. In fitting the Gundlach product curve to the required boiler fuel, the Cage-Paktor was a near perfect fit (Figure 4).

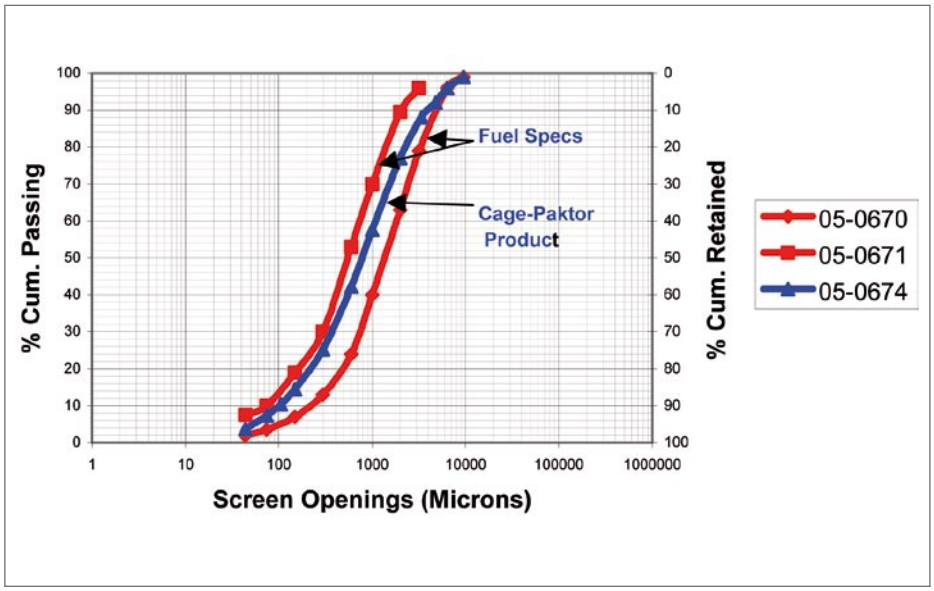


Figure 4. Boiler curve vs. Cage-Paktor product.

Producing this product without the use of expensive screens created a more simple operation at a much reduced capital cost, as well as a greatly reduced operating cost. At the high tonnages required of the crushers (700 tph) the screening system would have been extremely large, cumbersome and expensive.

Additionally, Gundlach tested the limestone to be used for the sorbent for the boiler. Again, through very precise sizing, the intended equipment planned in the specification was discarded and Gundlach Roll Mills (a special type of roll crusher) were specified to produce the 1 mm product required for the boiler. This equipment was actually sourced through a second engineering firm, not the same firm as that handling the fuel equipment.

After manufacture and shipment to site, these units were installed and tested. As is normal for these stringent needs, some minor problems arose, but were discussed, addressed and rectified in a timely manner. The result again was a solid operation on both the fuel side and on the sorbent side of the operation.

Conclusion

As can be seen, making a required product has many more facets than just what the top-size will be. It can be a very precise arrangement of percentages of certain size particles arranged in a 'product curve'. ■