SMALL MEDIA MILLING IN CONTINUOUS OR CIRCULATION MODE

by

ROBERT E. SCHILLING, ART RICHARD & MARGARET YANG
Union Process Inc.
Akron, Ohio

Presented October 15, 1998

by

Robert E. "Bob" Schilling

Suppliers Spotlite
1998 International Coatings Exposition
Ernest N. Morial Convention Center
New Orleans, LA

SMALL MEDIA MILLING IN CONTINUOUS OR CIRCULATION MODE

ROBERT E. SCHILLING, ART RICHARD & MARGARET YANG

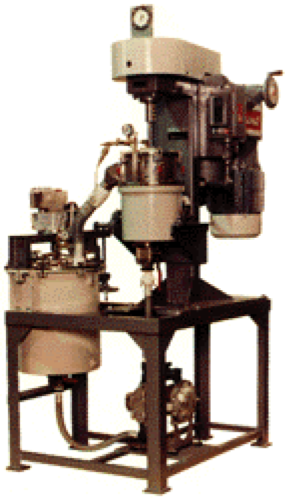
The paint coating industry is one of constant change and evolution. In the past thirty years, the industry has undergone rapid expansion and has faced rising product quality demands. In response to this, the raw material supply industries developed finer pigments and minerals that were much easier to grind and disperse. However, existing milling technologies could not utilize this latest development to its fullest advantage. Strict product quality tolerances along with finer pigments created the need for a new milling technology involving the use of much smaller media. The vertical sand mill developed by E. I. du Pont in 1950s was the first small media mill. From shot mills to horizontal mills to narrow gap mills, new and advanced small media milling technologies have continually developed.

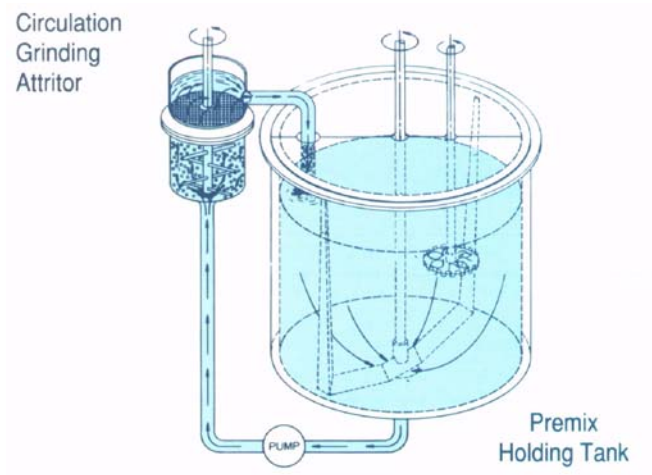
In addition to small media mills, there are numerous other types of media mills on the market today. Although each mill utilizes a different design, “media action” is the primary means by which effective grinding and dispersing is achieved. Since the grinding momentum is defined as (*mass* x *velocity*), mills with slower rpm (10 - 50) such as ball mills utilize larger and heavier media (12 - 50 mm). On the other hand, mills that use small media (2 mm and smaller) need to operate at much higher speed (2000 - 3000 fpm). Attritors fall in mid-range between the two extremes, using 3 mm to 10 mm and running at moderate speeds from 75 to 450 rpm (or 750 - 1000 fpm).

There are important factors to consider when selecting grinding media. Generally the coarser the feed material, the larger and denser the grinding media should be. Larger and heavier media is required due to the greater impact forces that can be generated. Final particle size should also be considered when choosing the appropriate media. The finer the end particle size that is required, the smaller the grinding media should be. Small media is effective for finer end particle sizes due to the greater surface area that is available to perform the fine grinding. Some manufacturing processes utilize the advantage of both large media and small media milling. One example of an efficient application would be to use a mill such as an Attritor to perform a first stage pre-grinding, then go on to the next step, process material through a small media mill to achieve the final polishing grind.

Continuous mode processing is the most common operation among small media milling methods. The earlier vertical sand mills and the horizontal mills that followed belong to this category.

In more recent years, many paint and mill manufactures have focused much attention toward a “new high circulation rate grinding’’ to achieve superior dispersions. In fact, this “high circulation rate grinding” is not a “new” technology. In 1976 Dr. Andrew Szegvari (the founder of UNION PROCESS) obtained a patent of this fast circulation grinding. And based on this technology, the Q Attritor (figure 1) was designed and manufactured. For many years, hundreds of different industries have implemented the Q Attritor in their grinding process successfully.





The Q Attritor combines with a large holding tank equipped with both a high speed disperser and a sweep blade low speed agitator in which the pigments and vehicle system are blended prior to milling. This tank also acts as an agitated re-circulation tank while the batch is milled to completion. The original Q Attritors are designed to use media size ranges from 3 mm to 10 mm.

<u>DMQ ATTRITOR</u>

The DMQ is the newest member of the small media mill family. It is a hybrid of the Deltamill and the QC mills. Like the Deltamill, it utilizes Delta discs. This proprietary design eliminates shaft whip and mill vibration, while providing much greater random media motion for improved milling efficiency. The mill is designed to accommodate media from 0.3mm to 1.0mm.

As with the Deltamill, the discs are indexed to provide directed and uniform media distribution throughout the mill chamber. The mill can be used in both continuous and circulation modes. All of the mills can be produced with metal-free components for certain ceramic applications where that may be a consideration.

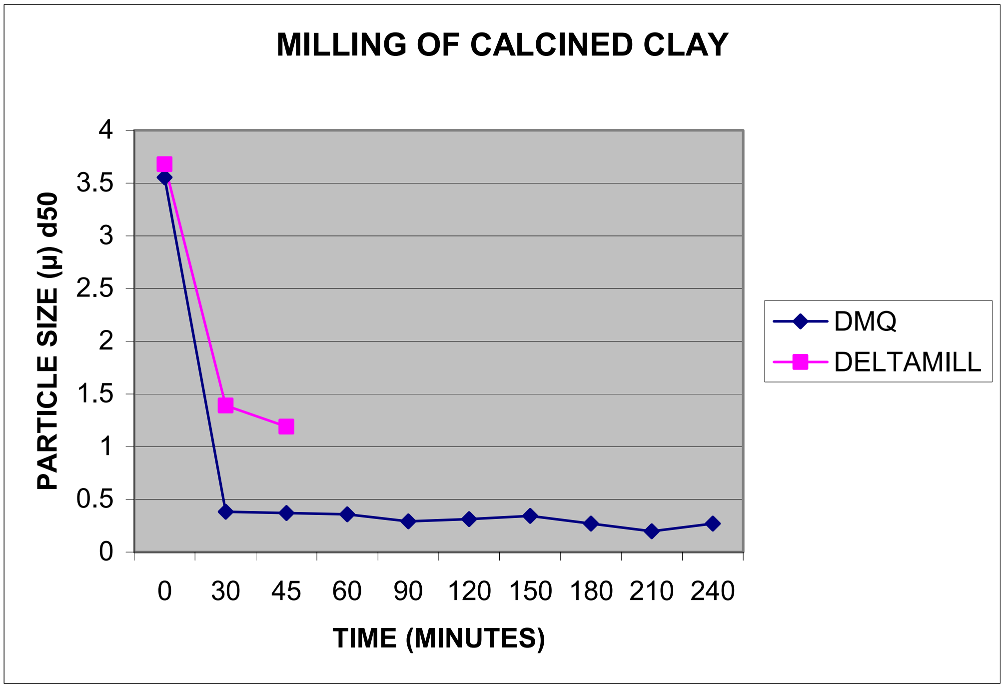
The mill incorporates the separator design like that used in the QC mill. It consists of a series of rings with the appropriately sized spacer between them and is thicker than the older wedge wire screen. This new design virtually eliminates plugging of the screen.

Thanks to this rugged and large open screen area positioned at the end of the mill, servicing and cleaning are much easier than with other mills. It's a simple matter to pull the cover off the end of the mill, which readily exposes the separator for servicing.

ADVANTAGES OF THE DMQ MILL

1. Operates in circulation or continuous mode
2. Uses media from 1 mm to 0.3 mm
3. Delta discs eliminate shaft whip and mill vibration
4. Delta discs provide greater random media motion
5. Indexed discs provide uniform media distribution
6. Service is fast and easy
7. More durable screening mechanism
8. Milling efficiency is improved

The graph shows the increased efficiency of the DMQ mill vs. the Deltamill grinding calcined clay with a starting size of 3.6 to 3.7μ.


MILLING OF CALCINED CLAY
PARTICLE SIZE (µ) d50
TIME (MINUTES)
4
3.5
3
2.5
2
1.5
1
0.5
0
0
30
45
60
90
120
150
180
210
240
DMQ
DELTAMILL