Maintenance Tips

Understanding the Grain Shape of Abrasive

By James Hansink, Barton Mines Corporation

The abrasive blast cleaning industry borrows heavily from the terminology of the geological sciences. For instance, the “sand” in “sandblasting” is most often quartz or slag grains in a range of sizes that geologists define as “sand.” Similarly, the concept of relative hardness adopted by the abrasive industry is taken from a term from mineralogy called the “Mohs number,” developed by Friedrich Mohs, a nineteenth century German mineralogist. His scale of hardness for 10 (some scales show 15) common minerals is widely used to set minimum limits on this property. The U.S. Navy’s specification for hull blasting media (MIL-A-22262SH) requires that abrasives have a hardness greater than 6.0 “on the Mohs scale.” Quartz sand has a hardness of 7.0, and Almandite garnet has a Mohs number of 7.5. Diamond is arbitrarily set at 10.

Understanding the terminology can help specifiers select the best abrasive for a job. This article describes another common geological notation used in the abrasive business, “grain shape.”

Blasters know that “well-rounded” grains have a peening effect on the steel. Slag producers often describe their media as “angular” and therefore more effective for “cutting.” “Angular” and “rounded” are derived from descriptions geologists developed for grain shapes in nature.

The American Geological Institute (AGI) has published a convenient reference to grain shapes, which is reproduced in modified form in Fig. 1.1

Specifiers may wish to refer to the AGI standards when calling for “angular” or “rounded” blast media. Most common media—silica sand, slags, garnet, or other natural minerals—fall naturally into the sub-angular to sub-rounded range (Fig. 2). A few media fall into the extreme ends of the definitions—well-rounded or very angular.

The figures also show that the overall shape of the grain, its length-to-width ratio, can be encompassed within the AGI definitions.

The shape of the abrasive grain affects the performance of the media. Very angular grains may tend to break down more readily than sub-rounded grains, forming greater amounts of dust. More rounded grains may present a larger surface area for contact with the steel, resulting in surface profiles that are deeper than expected.
This effect can also be understood by analogy. Suppose, for example, that a 16-pound (7-kilogram) bowling ball and a sixteen-pound (seven-kilogram) javelin are dropped from the top of a tall building to the roof of the car below. The round bowling ball makes a broader “profile” on the car’s roof than the “angular” javelin.

Like the size and hardness of an abrasive, grain shape can influence materials consumption, waste minimization, dust generation, environmental compliance, and surface profile. All of these items significantly affect total project cost.

Reference


Tips on Sizing Dehumidification Equipment

By Charles H. Wyatt, Enviro-Air Control Corporation

High humidity can hamper blasting and lining application operations, causing flash rusting on freshly blasted steel and incomplete cure of coatings and linings. Dehumidification, the removal of moisture from the air, can help prevent flash rusting as well as premature lining failure resulting from application over moisture or improper cure. This Maintenance Tip briefly describes the types of dehumidification equipment suitable for blasting and coating operations, and it explains the basic formula for sizing dehumidification equipment based on the size of the enclosure in which the project will take place. “Enclosure,” as used in the present article, includes tank and vessel interiors as well as plastic or canvas containment structures attached to tank exteriors for operations such as lead-based paint removal, unless the air flow is mandated by either federal or state regulations.

Types of Dehumidification

As described in NACE Publication 6A192, *Dehumidification Equipment in Lining Application*, 4 types of dehumidification are available.

- Condensation-based (refrigerant). This method has the incoming air cross over evaporator coils to reduce the absolute amount of moisture in the air through condensation. The air then passes over both condenser coils and a series of reheat coils to increase the temperature of the incoming air and reduce the relative humidity of this air.
• **Solid sorption (desiccant).** This method uses a chemical to directly absorb moisture from the air while it is a vapor. Specifically, a moist air stream is passed over a desiccant that absorbs the moisture. The desiccant is then heated, forcing it to give up the absorbed moisture and regenerating the desiccant for continuous use. The heat of regeneration causes the air entering the enclosure to be substantially higher than the ambient air.

• **Compression of the air.** This method reduces the absolute moisture content of the air but will generally produce a saturated condition at the elevated pressure.

• **Liquid sorption.** In this method, the air is passed through sprays of a liquid sorbent, which then absorbs the moisture from the air. The sorbent must be continually regenerated by using heat to drive off the absorbed moisture.

Only the refrigerant-based and the solid sorption types are suitable for maintenance painting.

### Sizing Dehumidification Equipment

While there is a disagreement in the industry over the number of air exchanges per hour necessary to properly size the equipment, the basic formula remains the same.

CFM (of equipment) = Volume of enclosure • X • 1/60

where X is the number of air exchanges per hour required (or desired) and CFM is the cubic feet per minute that the equipment can exchange.

As a general rule for sizing dehumidification equipment, 4 air exchanges per hour are recommended. To determine the size of the dehumidification equipment for a tank 90 ft (27 m) in diameter with a seven-foot (two-meter) floating roof and 90 ft (27 m) in diameter and 40 ft (12 m) tall, use the following formula.

Volume (V) = 3.14 • (radius) • (radius) • (height)

For the floater, V = 3.14 • (45) • (45) • (7) = 44,509 cubic feet (1,460 cubic meters)

For the total tank, V = 3.14 • (45) • (45) • (40) = 254,340 cubic feet (8,341 cubic meters)

CFM = V • (ft³) • number of air exchanges per hour • 1/60 (to convert from hours to minutes)

In the case of the above 2 examples, the dehumidification sizing for the floater is

CFM = 44,500 • 4 • 1/60 = 2,967 CFM = 1-3,000-CFM dehumidification unit
For the total tank, the sizing is

\[ \text{CFM} = \frac{254,340}{15} = 16,956 \text{ CFM} = 2 \times 7,000-\text{CFM units and 1-3,000-\text{CFM unit} \] 

The use of properly sized dehumidification equipment will improve productivity, scheduling, safety, and lining performance.

Note


What Contractors Should Know about Garnet

By Lindsay Gorrill, Emerald Creek Garnet Company

The cost of product liability and disposal costs of spent abrasive combined with the outright banning of some of the lower cost alternative abrasives for certain applications have increased the cost of abrasive blasting.

To offset this increased cost, some contractors have experimented with increasing the effectiveness of the abrasive. For example, in the case of garnet, a generally more expensive abrasive than what was used in prior years, recycling has been used where containment is possible or required by state and federal agencies. Also, by monitoring abrasive usage and blasting pressure and with improved labor techniques, contractors can take advantage of increased efficiencies achievable with garnet to help offset the higher cost of the abrasive. This Maintenance Tip is intended to help readers understand differences among the varieties of garnet and how to optimize the performance of garnet on blasting projects.

What Is Garnet?

Garnet is not a single mineral. Rather, it is a group of minerals that share a common crystalline structure and a similar chemical composition. The most common varieties of commercially available garnet are Almandite (or Almandine) and Andradite. Although Almandite is the heaviest and hardest and Andradite is the lightest and softest of the garnet family, both are relatively hard and relatively heavy.

A more important attribute not necessarily associated with the chemistry is how the garnet was formed. Because of their hard rock deposit formation, all of the deposits of Andradite and some of the Almandite garnets are structurally weaker than full crystal alluvial Almandite garnets. In hard rock
garnet deposits, many crystals can make up a particular grain size. A high number of crystals in each grain means the grains are more friable or break down more easily. This tendency to break down results in a greater level of finer particles of dust, slightly lower performance in a one-time use, and a reduced ability to be recycled. Usually, the lower performance is partially offset by the lower price of the Andradite compared to the Almandite.

A very simple friability test will go a long way in understanding how a particular garnet will break down and generate dust.

- Place about 10 grains of each type of garnet you are considering on a flat, hard surface.
- By using a quarter and the pressure of your thumb, try to break each grain of garnet individually, if possible.
- The easier it is to break the grain, the higher the dust levels will be and the fewer times you can recycle the garnet. For recycling projects, choose the sample that is hardest to break.

It is imperative that the end user (contractor) acquire samples of each garnet product under consideration. At most, a quarter of a pound of each is needed. The friability test should be performed before ordering a particular type of garnet. When the selected product is delivered to the job site, the test should be done on the product at the site to see if it is comparable to the sample. Because everyone exerts different pressure, the test gives only a relative indication of friability.

All garnets do not yield the same profile, cutting speed, and recycling ability.

The harder, full crystal garnets (Almandite) will generally yield faster cutting speeds and lower dust levels than the more friable, fractured garnets (Andradite).

**How Nozzle Pressure Affects the Performance of Garnet**

Varying air pressure at the nozzle affects the cutting speed and recyclability of garnet. Since Almandite is harder, heavier, and more impact resistant than Andradite, an increase in nozzle pressure will normally yield greater cutting speeds of up to 120 psi (827 kPa). Almandite garnet may increase productivity by more than 40 percent compared to productivity when blasting with conventional low cost media.

If air pressure cannot be varied, productivity may still be enhanced by closely regulating the flow of the abrasive from the blast pot. Generally, garnet will require substantially less abrasive per square foot (square meter) of surface than other conventional abrasives.

For optimal recycling, the ideal pressure range is 80 to 90 psi (552 to 621 kPa). For the better quality garnet, these pressures will yield a breakdown rate of 85 percent to 95 percent. (That is, 85 percent to 95 percent of the abrasive is re-usable.) Therefore, users of recyclable garnet need to decide
the appropriate trade-off between pressure (cutting speed) and breakdown of the material. Lower quality garnet will yield a breakdown rate below 50 percent. The higher the breakdown rate, the more durable the product. Breakdown is measured by calculating the percentage of product retained on a 100 U.S. screen after a series of blasts. This calculation will provide the average amount of usable product, from the working mix, after each blast. A 100 U.S. screen was chosen to optimize the cutting speed of the blend, but based on the blaster’s sensitivity to dust levels compared to the number of recyclines, the screen size can be changed.

For recycling projects, a working mix is maintained where normally a virgin coarser grade of garnet is added to the recycled abrasive. During recycling, garnet tends to separate cleanly from contaminants associated with the job. This is due to the hardness of garnet and the fact that it is virtually impossible for a contaminant to imbed in the garnet crystal. Recycling can normally be achieved with air and vibration, and, if drying is necessary, a rotary dryer can also be used.

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