

# Non-Abrasive Plastic Blast Media For Mold Cleaning Operations

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*Blast cleaning of rubber molding equipment using plastic media offers substantial benefits to manufacturers. Wear and pitting damage rates can be reduced, cleaning times shortened and the cost of both the equipment and the blast media offers substantial economic benefits.*

New processes that contradict traditional thought are by human nature resisted, as we are all resistant to change. This is especially true nowadays when we have come to expect complex, technical, and expensive solutions to industrial problems.

With the introduction of non-abrasive plastic blast media for mold cleaning, many of the problems that molders of industrial rubber goods encountered in the past have been solved at low cost.

Plastic blast media for cleaning molds, and also for other applications such as stripping of paint and coatings, have brought these industries safe and cost-effective solutions to traditional cleaning problems.

For many years rubber molders have used abrasives such as glass bead and steel shot to clean molds. Those concerned about the significant mold wear caused by these abrasive blasting methods switched to soaking molds in chemicals. Chemical soaking was non-abrasive to molds but created another set of problems, among which was the operator safety factor and the disposal of hazardous waste.

This article will educate the reader on the significant advantages of plastic media over other processes and how the molder can save time and money, and nearly eliminate mold wear due to mold cleaning. Also covered is the significant advantages of the plastic media compatible direct pressure blast systems for efficient cleaning and handling of large and small molds.

## Technical Factors

There are a number of plastic media available for applications such as deflashing of rubber and plastic parts and deburring of die cast parts, amongst others. The media utilized for cleaning molds, however, are amino thermoset resin formulations of melamine and urea referred to as MC (melamine) and MB (urea).

Melamine and urea plastic formulations are well known as the hardest plastics in the world. Because of their high hardness level, a molder can literally 'sandblast' with these media particles at high pressures, such as 50-60psi, on molds and cause no pitting or damage to the mold. The surfaces of the steel or aluminum molds are completely cleaned and no

surface erosion occurs. Even though the plastic media are 'hard', their hardness relative to steel and aluminum is low, thus causing no mold pitting.

Table 1 displays the technical characteristics of the plastic media in relation to softer and harder abrasives. Note the only abrasives that are softer are natural materials, such as walnut shells. Walnut shells will also clean molds to some extent but rapidly break down and round off, which renders them ineffective and too dusty to view the mold after a short period of time. Glass bead and steel shot both will clean the mold, but all too well. The key to non-abrasive cleaning is to remove any contaminant from the mold surface without affecting that surface in any way.

Figure 1 displays the significant surface erosion caused by abrasives. Even though the residue is removed, so is the mold surface. This is the negative action that requires elimination.

## Necessary Equipment

Today's blast equipment used to clean molds has evolved around lightweight plastic media. Plastic media is easy to transfer from pressure vessels or storage hoppers. The machines are also self-contained in order to retain the media, thereby gaining the maximum benefit.

The photograph shows a typical mold cleaning system. Although it has the appearance of an ordinary blast cabinet, it has special features which enhance the use of plastic media. The plastic granules are recycled in this system. This feature makes the dry blast process very economical since the media is used over and over until it becomes an airborne dust particulate. At this point, the specially designed cyclonic air wash pulls these fragments into the dust collector, leaving usable media inside the cabinet, which is continuously being screened at the hopper level. A vibrating screen removes any large particulate which might come from a mold being cleaned, thereby preventing the media from becoming contaminated.

A track extension and mobile workcar provide easy handling of any heavier molds being cleaned and the mold can be maneuvered inside the cabinet by rotating the turntable. The blast nozzle inside the cabinet is directed toward the parts of the mold being cleaned. A large view window and bright lighting provide good visibility for the operator.

The system requires little, if any, maintenance. Since the plastic media is non-abrasive, it does not wear out the inside of the cabinet as harsh abrasives can, and replacement of rubber gloves and hoses is usually the only maintenance required. The daily removal of the dust particulate caught in the dust collector drawer is also easily managed.

The major advantage when considering plastic media for blast cleaning is its ability to clean quickly

with no mold wear. Since molds must be cleaned on a regular basis, it is important to clean the mold quickly, without damage to parting lines or surface finish.

Advantages of using blast cleaning systems include the fact that the dry waste left over after the media has been recycled many times is not a disposal hazard as can be the case with chemical solvents, and plastic media do not produce silicosis hazardous dust. The blast cabinets are pneumatically operated and easily serviced by ordinary maintenance personnel.

## Blast Test Parameters

The major advantage of plastic media blasting and its non-abrasiveness was determined by the dimensional erosion of a mold surface when using various blast cleaning methods. The objective was to measure the effect of both glass bead and plastic media on steel over a long period of time. The experiment established comparative metal removal rates using a hard grade plastic media, chemical type melamine (Maxi-Blast product designation: MC), and glass bead. The blasting was conducted on steel coupons representing typical alloys used for the manufacture of rubber molds.

The specifications of the test coupons were: 'Freemax 45' hot rolled steel, machined and ground to 3.175mm x 50.8mm x 76.2mm, not heat treated. The hardness of the coupons was Rockwell 26B or Brinell 145,500kg load.

The test parameters were established as follows:

- Blast machine: suction style blast cabinet with remote portable hopper;
- Blast gate setting: 53.975mm open;
- Suction tube setting: 50% open for plastic media, 90% open for glass bead;
- Blast gun: syphon type 7.94mm carbide nozzle and 3.97mm air jet fixture;

- Blast pressure: 80psi (558.8 x 103 pascal) on machine gauge;
- Blast angle: 80°, nozzle tip 152.4mm from coupon surface.

The test procedure conducted began with loading the portable hopper with 22.68kg of new media. Then a coupon was weighed to the nearest 0.0001g and recorded before the blast test.

Next the coupon was placed with the flat surface toward the blast nozzle in a holding device to precisely locate it in relation to the media blast pattern. The coupon was blasted for 20 minutes, weighed and recorded and blasted again with weights recorded at 40 and 60 minutes. During the test, the blasting was stopped after 30 minutes to weigh the media remaining in the portable hopper. The recorded media weight was subtracted from the original 22.68kg charge and multiplied by two to establish the media flow rate per hour.

The media flow rate for both the plastic media and glass bead was 40.82kg per hour. The portable hopper was then recharged with the media collected in the cabinet hopper from the first 30 minutes of blasting and the test was continued with the recycled media.

Upon completion of 60 minutes of blasting, the depth of the eroded area on the test coupon was measured. The comparison of the dimensional erosion of the steel coupon is recorded in Figure 1. Maxi-Blast also gathered data to compare the cleaning times, equipment and material costs and waste disposal costs of different cleaning methods. The information in Tables 2 and 3 has been collected through interviews with customers, contact with industrial chemical suppliers and observation of cleaning activities.

## **Results and Discussion**

### *Mold wear*

As indicated, the reduction or elimination of factors that break down or wear a mold, thus extending its working life, is critical to every rubber molder. The cost of replacing or reworking the average steel mold starts at about US \$10,000 and can reach six figures.

When rubber parts are molded, there is always a flow of compound across the cavity surfaces, coupled with the forces of the press to hold the mold plates together. The resulting rubber compound flow and crush formulation and adjustment of the press clamping pressures and heat cycles can

**Table 2: Comparison of cleaning times**

Mold Type	Dimensions	# of Cavities	Product Molded	Blast Cleaning Time (min/plate, sec/cavity)	Hand Cleaning Time <sup>1</sup> (min/plate, sec/cavity)	Chemical Time <sup>2</sup> (min/plate, sc/cavity)
tool steel	24in <sup>2</sup>	100	SBR O-rings	8-10; 4.8-6	17-25; 10-15	30min.-8 hours
tool steel	24in <sup>2</sup>	150	Natural/SBR bushings	10-12; 4-5	25-38; 10-15	30min.-8 hours
tool steel	24in <sup>2</sup>	200	Silicone grommets	15-20; 4.5-6	34-50; 10-15	30min.-8 hours

1: Hand cleaning times are based on the approximate duration to completely cover all cavity areas on molds of simple design. More intricate molds will require more attention and take longer to clean.

2: Chemical soaking times reflect only the process of loosening baked-on residue. After the soaking time, the molds need to be rinsed and may require additional cleaning efforts.

Another consideration is the design of the mold itself. If the molded parts are complex, the mold cavities will have an intricate design that will require more time to reach all surface areas, as well as to tear down then reassemble. The time figures presented in Table 2 reflect the efforts of hand cleaning on molds of simple design. For this method, cleaning time is in hours and is not practical when fast turnaround is required.

When cleaning molds with chemicals, the time and labor involved in the process can be deceiving. Generally, very little labor is required to load and remove molds from chemical tanks or ultrasonic cleaners. The rinsing process is also relatively simple and not time consuming. However, the actual time that molds must soak in chemical systems ranges from as little as 30 minutes up to eight hours or more. For molds that are run continuously, this lost time is unacceptable.

The longer soaking times also require considerable energy to maintain the proper heat of the chemicals and/or the agitation present in ultrasonic cleaners. One aspect of chemical cleaning times that is often overlooked is the impact of incomplete removal of all residues. After a mold has soaked for four to six hours, it sometimes requires additional hand cleaning or blasting.

Dry blast cleaning of molds is the method that consistently provides fast and thorough cleaning. Properly prepared blast equipment will allow effective cleaning of molds in the minimum amount of time. Mold design does not affect cleaning times since the blast process will project particles into narrow and recessed areas with velocities equal to those achieved on flat areas. Plastic media has an advantage over glass bead media with regard to cleaning times. Because plastic media is non-abrasive, operator error is eliminated. The operator does not have to worry about overexposing the mold surface and can be more efficient in achieving complete residue removal. If blast pressure is lowered to avoid damage from glass bead, cleaning times may be longer than necessary. With plastic media, the blast pressure can be set at the optimal level for the fastest cleaning possible.

*Material and equipment costs*

Many costs involving mold cleaning equipment and materials are misinterpreted. The idea of investing in a machine that does not make a part or directly contribute to a part can receive little attention. The attitude that “we have done it this way for years, why change now” can prevail and clouds the analysis of the facts. Table 3 examines the cost comparisons of the three cleaning

methods in more detail. Hand cleaning of molds does not involve capital expenditure on equipment. Hand power tools that would be used are low cost and can often be acquired from the supply room without management approval. The materials used for hand cleaning – ScotchBrite pads, brass brushes, and some solvents – are also low cost. Actual figures for these items are very difficult to acquire simply because no one typically tracks them. Some of the materials are used in other areas of production, especially cleaning solvents. If these costs were more closely tracked they could be quite surprising.

Of particular note is the use of cleaning solvents. The costs of caustic and hazardous materials is constantly rising and availability is diminishing, not to mention the environmental concerns and responsibilities that their use engenders.

Chemical cleaning is theoretically easy – just get a ‘tub’, dump a couple of drums of ‘highly potent stuff’ in it and drop a mold inside. In reality, it is not quite as simple as this to set up and operate a chemical cleaning system. Environmental and worker safety issues have demanded that the chemicals used in industry be handled under stringent guidelines for everyone’s protection. The equipment, dip tanks and ultrasonic

**Table 3: Comparison of equipment and material costs**

Cleaning Method	Equipment Investment	Material/Media Cost	Disposal Cost
Plastic Media Blasting	US \$5,000-12,000 <sup>a</sup>	US \$625 <sup>b</sup>	None
Glass Bead Blasting	US \$5,000-12,000 <sup>a</sup>	US \$410 <sup>c</sup>	None (glass mineral waste may be restricted in some states)
Hand Cleaning	N/A	Undetermined	None, unless solvents are used
Chemical Cleaning	Dip Tank: US \$5,000-25,000 Ultrasonic: US \$7,000-20,000	Methyl Ethyl Ketone: US \$300-500 <sup>d</sup> Toluene: US \$150-300 Trichloethylene: US \$430-600 Methylene Chloride: US \$250-400	US \$500-1,200 per drum classified as hazardous waste

a: dry blast cabinet, direct pressure style system  
b: per 250lb. drum  
c: based on 1,000lb; there is an approximate 4:1 glass bead : plastic media usage factor  
d: all chemical costs are 55 gallon drum, if available

cleaners are manufactured with ever more elaborate designs and controls to ensure efficient operation and safety.

US Environmental Protection Agency and Occupational Safety and Health Administration regulations also require effective ventilation systems to collect and process toxic fumes generated by the process. This has caused equipment costs to rise significantly and they no longer enjoy an economic advantage. Small tanks start at the same price or higher than small cabinets and the largest tanks far exceed the price of large blast cabinets.

Beyond the equipment, the chemicals used have become the most dynamic cost factor of this cleaning method. One drum of the most commonly used chemical will cost several hundred dollars and more than one drum could be needed to fill a larger dip tank. Often the freight cost for caustic and toxic chemicals is higher because of the risk incurred by the carrier. There is also the diminishing availability of certain chemicals that are being banned because of toxic emissions. Replacement chemicals are being formulated, but their cost is expected to be higher and their performance will be subject to questions. Table 2 lists a few chemicals commonly used and approximate prices per drum. Far

and above the initial cost of chemicals is the cost of disposal once they become ineffective. Not included is the potential cost of alleged improper disposal.

Blast cabinet systems recommended for mold cleaning are designed with positive feed pressure vessels to maximize media velocity and provide the fastest cleaning possible. Investment for a blast cabinet is controlled by the size of the cabinet enclosure needed and the weight capacity. Starting at about US \$5,000, blast cabinets will top out at about US \$12,000 unless molds are unusually large or certain special features are requested. Material or media costs are also very economical.

Table 3 compares the cost of a drum of plastic to the other materials, specifically glass bead. What is important when comparing plastic media cost to glass bead is the usage ratio. Maxi-Blast has monitored customers' plastic media usage against their previous use of glass bead for a period of years. Given the weight to volume difference (glass bead is twice as heavy as plastic media), size difference (commonly used sizes: glass bead at 100/170 mesh and plastic at 20/30 mesh) and performance characteristics, customers used about 4 lbs. of glass bead to every 1 lb. of

plastic media. This factor drastically reduces the price advantage held by glass bead media.

Further review of cost factors involving blast cleaning reveals the hidden cost of equipment maintenance when comparing plastic media and glass bead. Not only is glass bead abrasive to molds, it is also abrasive to the blast equipment.

Weld-joints, door seals, work floors and surfaces, media mixing valves, piping and blast nozzles are all worn by glass bead in addition to the rubber blast hose and rubber gloves. Plastic media will not wear the metal components of a blast cabinet, resulting in an unlimited life for such key items as mixing valves, piping and nozzles. Wear will be experienced in blast hose and gloves, but this is to be expected.

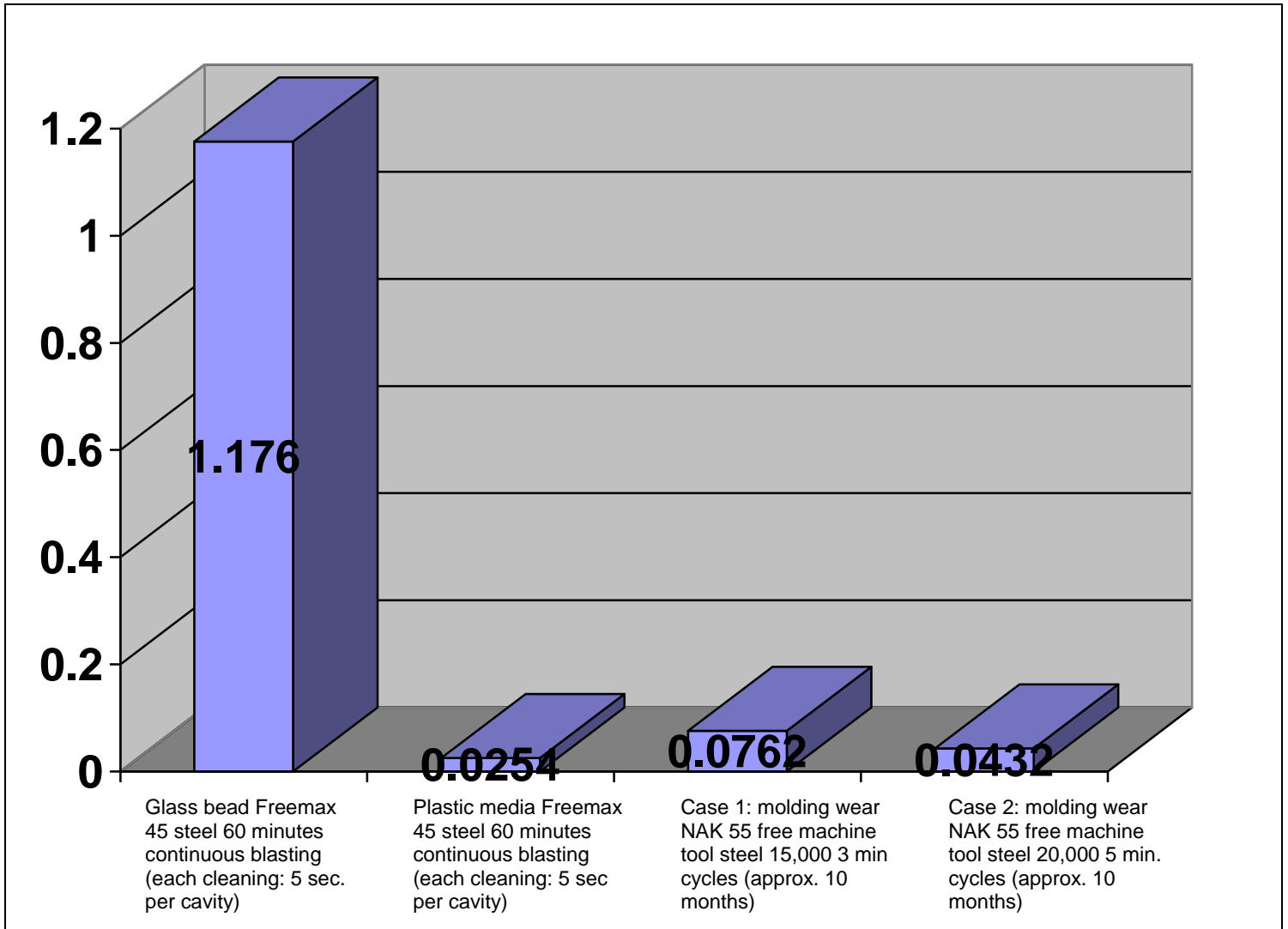


Figure 1: Dimensional erosion of steel surfaces comparing blast cleaning and molding wear