EVALUATION OF ABRASIVE RECYCLING CHARACTERISTICS OF SEVERAL ABRASIVES IN VACUUM BLASTING EQUIPMENT

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Vacuum blasting has proven itself as an effective and productive tool in the removal of lead paint coatings from residential and industrial structures. Recyclable abrasives have typically been associated with this process, and equipment capable of recycling back abrasive materials back to the nozzle. One of the factors affecting the overall cost of vacuum blasting is the amount of times a material can be recycled and still perform it's surface preparation function. This paper will evaluate the recyclability characteristics of several abrasives, both metallic and non-metallic in automatic, continuously recycling, vacuum blasting equipment.

For this evaluation two types of garnet, two types of steel grit, three types of aluminum oxide, and one coal slag were tested for recyclability in a LTC 1060 Pn vacuum blasting machine. The LTC 1060 Pn has been selected for it's unique and patented capability to be able to continuously recycle and reclassify the abrasive media during the blast cleaning operation, and its ability for this evaluation to control several variables associated with abrasive recycling. To gauge the relative recyclability of the abrasives tested, each abrasive will be loaded into the LTC 1060 Pn vacuum blasting machine, with the blast head affixed to a metal bar. The machine will be operated for a period of time, and the number of pounds abrasive waste generated will measured. This number will be divided into the amount of abrasive blasted to determine an effective or apparent recycling rate for that test.

Evaluation Program

There are several variables besides the abrasive type and manufacturer, which will affect the rate at which an abrasive is consumed in vacuum blasting equipment. They include the following:

1. Blast Pressure
2. Abrasive Feed Rate
3. Nozzle type, and geometry with respect to surface
4. Dust Separation system
5. Substrate material

For this evaluation items 1, 3, and 4 have been kept constant by employing a standard LTC 1060 Pn vacuum blasting machine for all abrasive recycling tests. The operation of the LTC 1060 is described in

reference 1, and visually represented in Figure 1. In the 1060 the blast pressure can be monitored and kept constant by a pressure regulator internal to the system. For these tests the blast pressure was set at 80 psi, a typical value for this equipment. The relationship of the nozzle to the surface is also kept constant by using a standard LTC 1060 blasthead affixed to a steel bar as shown in Photograph 1. In this configuration the 1/4" (No. 4) boron carbide medium venturi nozzle tip is approximately 8" from the surface of the bar (See figure 2). Each test was run with the blasthead affixed to this same steel bar. The dust separator employed is standard LTC 1060 dust separator.

The abrasive feed rate can be controlled by adjusting an abrasive control valve located on the equipment. For each abrasive the abrasive feed rate was adjusted to allow for the most efficient cutting rate, as determined visually by the operator.

The equipment test set up is outlined in Figure 3.

The testing program consisted of the following:

1. Fill the machine's double pressure vessel and hopper (approx. 1.4 cubic feet total) with virgin abrasive to the fill line in the machine hopper.
2. Adjust the abrasive flow rate to optimize the cutting speed.
3. Test blast 3 square feet of epoxy paint coating (approx. 2 mils thick) on a tank structure. Record the time required to clean the surface to SP10. Take a profile measurement of the cleaned surface.
4. Test blast for one minute into an abrasive sampling bucket and weigh the contents to determine the abrasive feed rate.
5. With the blasthead affixed in the test fixture, test blast for the required time.
6. After test blasting, backflush the filter system, remove and measure the contents of the waste drawer.
7. After testing of a particular abrasive has been completed empty machine of all abrasive.

For each of the following abrasives (see table 1 for abrasive data) the above test program was conducted:

1. General Abrasives, No. 36 Lionblast Aluminum Oxide
2. General Abrasives, No. 24 Lionblast Aluminum Oxide
3. General Abrasives, No. 24 Lionite Aluminum Oxide
4. Barton Mines, Australian Garnet (30/60)
5. Barton Mines, CG 16 Garnet
6. Ervin Industries, G25/40 LG Steel Grit
7. Chesapeake Specialties, G25/40 Steel Grit
8. Reed Minerals, Black Beauty, Medium Grade

These materials were chosen because of their past use in LTC vacuum blasting equipment and their capability to clean steel surfaces to white metal

and impart a profile required typically prior to recoating.

Summary and Analysis of Results

Table 2 lists the test results. As would be expected, the steel grit exhibited greater recyclability characteristics, than the other abrasives tested. The recyclability factor for the steel grits (600 and 660), however, may be skewed on high side because of the relatively few amount of times the grit was actually cycled through the equipment. (approx. 10-15 times).

It should be noted that though these tests demonstrated recyclability of factor of 4.8 to 7.3 for the aluminum oxide abrasives frequently used in LTC equipment, past tests and project studies indicated higher recyclability factors on the order of 7 to 10.0 and abrasive usage rates of 40 to 55 pounds per hour.

This can possibly be explained by the hypothesis that higher rates of abrasive breakdown will occur when blasting on bare steel as compared when removing coatings, from steel surfaces. The coated steel surface is more "elastic" or softer when first removing the coating from the harder substrate, thus causing less wear or breakdown of the abrasive.

Metallic vs. Non-Metallic Abrasives

Both metallic and non-metallic abrasives have been used successfully on vacuum blasted lead paint removal projects. One word of caution is put forward concerning the use of metallic abrasives. While it is apparent that the recycling characteristics are many times greater than the non-metallic abrasives tested, more care is required in their use than generally required for the non-metallic abrasives. This first includes the requirement for very dry air. Wet air can cause re-rusting of the surface being blasted, cause rust on the abrasive material, and also potentially lead to rusting of the steel grit in the hoses and vessel of the equipment. LTC recommends the use of a deliquescent or desiccant type dryer for all steel grit vacuum blasting applications. The non-metallic abrasives can accept less dry air without causing degradation to the abrasive or fouling equipment. For these abrasive applications LTC recommends as a minimum the use of a properly sized air cooler and water separator.

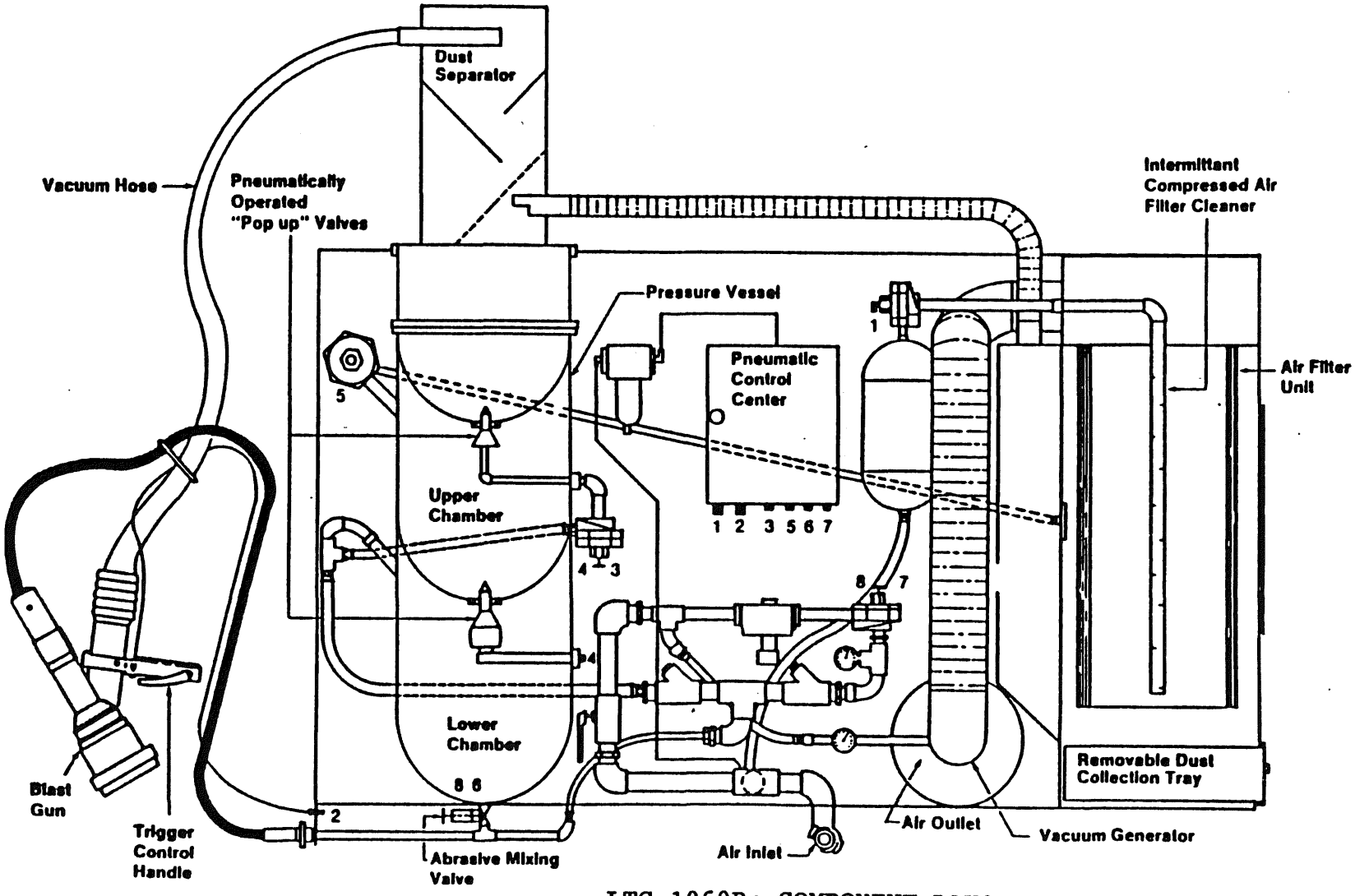
Additionally as vacuum blasting is a operator dependent on maintaining a seal of the blasthead shroud on the surface being cleaned, any deviation from this seal can cause abrasive to be leaked from the blasthead. The resulting spillage on the surrounding environment has the potential to stain the surface it comes to rest if it comes in contact with water, and if a large quantity is spilled it has the potential to rust together into clumps, making removal difficult.

The use of steel abrasive in vacuum blasting equipment also requires more vacuum capability to fully recover all materials at the blasthead for a given hose length, as compared to nonmetallic abrasives. This is mainly due to the fact that steel abrasive weighs roughly

two times that of the non-metallic abrasives. Heavier weight per grain requires greater air velocities, to move the abrasive back the vacuum recovery line, hence more energy, to recover the steel grit.

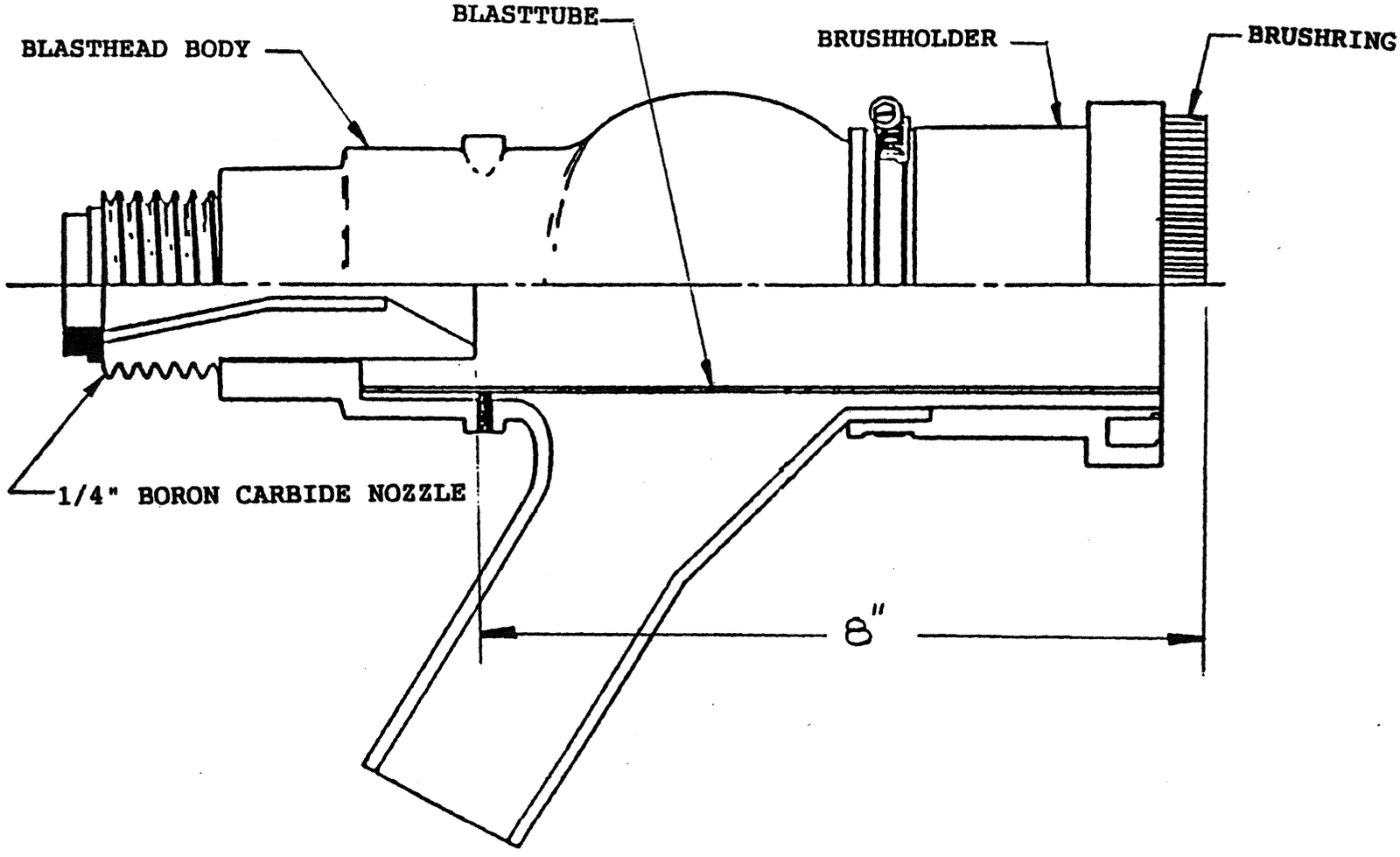
Use of Fine and Light Abrasives

While this study evaluated the use of relatively coarse abrasives, vacuum blasting equipment has effectively been used with fine abrasives, both metallic and non-metallic, and soft abrasives such as plastics and walnut shells. Limited testing of walnut shell abrasives using similar test configurations demonstrated recyclability factors of 15-20.



LTC 1060Pn COMPONENT LAYOUT

FIGURE 1



VACUUM BLASTHEAD TEST CONFIGURATION GEOMETRY

FIGURE 2

ABRASIVE CHARACTERISTICS

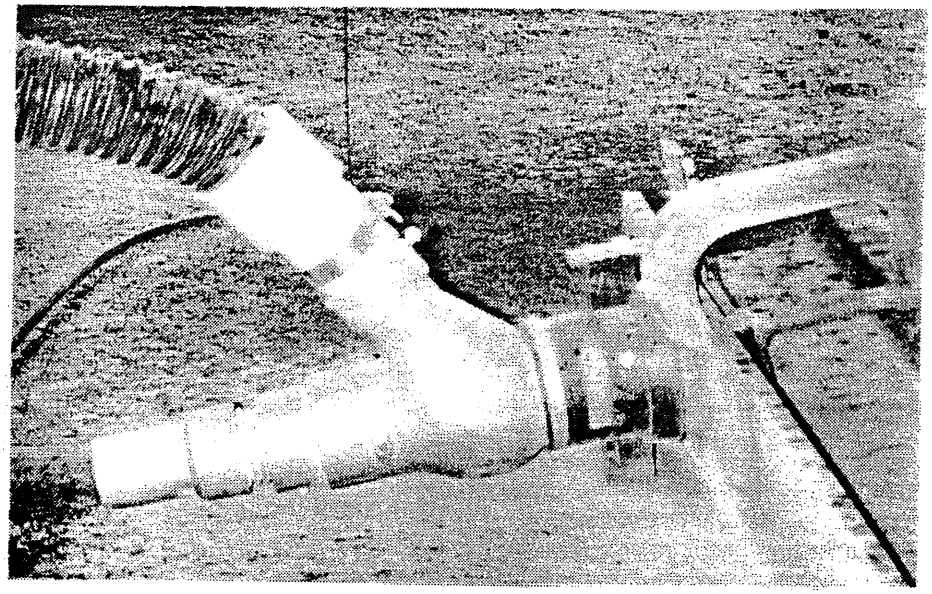
ABRASIVE TYPE	MANUFACTURER	GRADATION	HARDNESS (MOHS)	BULK DENSITY LB/FT 3	APPROX. COST PER POUND
ALUMINUM OXIDE LIONBLAST	GENERAL ABRASIVE	NO. 26	9.5	117	30 - 50
ALUMINUM OXIDE LIONBLAST	GENERAL ABRASIVE	NO. 24	9.5	120	30 - 50
ALUMINUM OXIDE LIONITE	GENERAL ABRASIVE	NO. 24	9.5	120	30 - 50
STEEL GRIT	ERVIN INDUSTRIES	G25/40 LG	50 - 60 ROCKWELL "C" SCALE	270	25
STEEL GRIT	CHESAPEAKE SPECIALTY PRODUCTS	G25/40	45 ROCKWELL "C" SCALE	270	17 - 18
GARNET	BARTON MINES	AUSTRALIAN 30 - 60	7.5	150	15
GARNET	BARTON MINES	CG - 16	8 - 9	125	18 - 22
COAL SLAG	REED MINERAL	MEDIUM BLACK BEAUTY	7	90	5 - 8

TABLE 1

TEST RESULTS

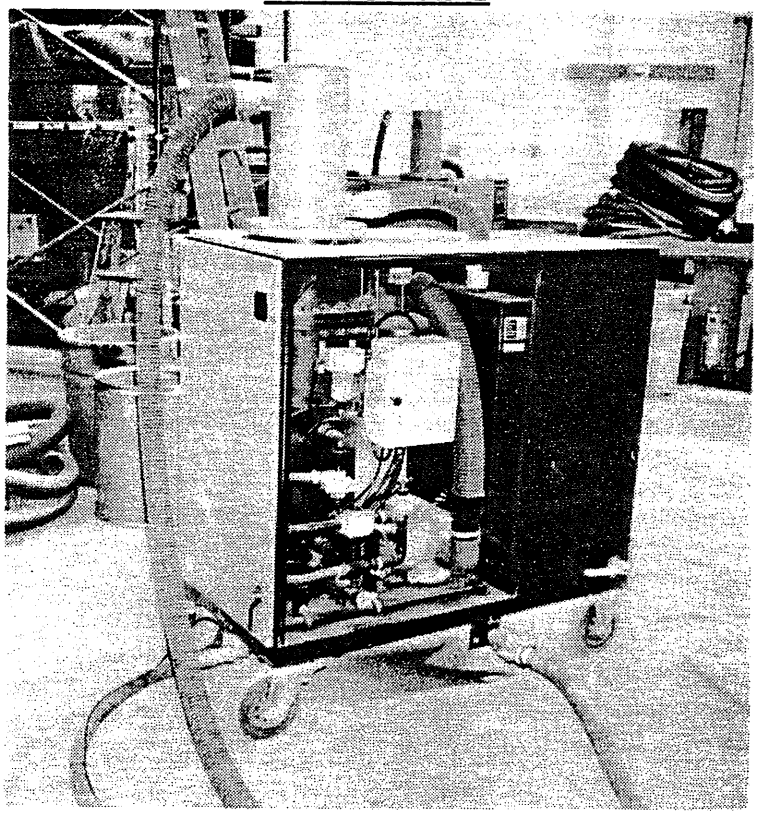
ABRASIVE TYPE	MANUFACTURER	GRADATION	ABRASIVE FEED RATE (LB/HR) (MILS)	TIME TO CLEAN 3 SQ FT (MIN)	PROFILE MEASUREMENT	TEST DURATION (HR)	LB'S OF WASTE PER HOUR (LB)	RECYCLABILITY FACTOR
ALUMINUM OXIDE LIONBLAST	GENERAL ABRASIVE	NO. 36	450	3.0	2.3	2 HR	61.5	7.3
ALUMINUM OXIDE LIONBLAST	GENERAL ABRASIVE	NO. 24	330	3.6	3.6	4 HR	68.3	4.8
ALUMINUM OXIDE LIONITE	GENERAL ABRASIVE	NO. 24	360	2.6	3.3	2 HR	68.0	5.3
STEEL GRIT	ERVIN INDUSTRIES	G25/40 LG	660	3.2	3.2	4 HR	1.0	660
STEEL GRIT	CHESAPEAKE SPECIALTY PRODUCTS	G25/40	1030	3.7	2.5	4 HR	1.8	600
GARNET	BARTON MINES	AUSTRALIAN 30 - 60	660	2.1	1.5	1 HR	138	4.7
GARNET	BARTON MINES	CG - 16	645	2.9	2.8	.5 HR	124	5.2
COAL SLAG	REED MINERAL	MEDIUM BLACK BEAUTY	600	2.8	2.0	.5 HR	184	3.2

TABLE 2



VACUUM BLASTHEAD TEST SET-UP WITH BLASTHEAD CLAMPED TO STEEL RAIL

PHOTOGRAPH 2



LTC 1060Pn VACUUM BLAST TEST MACHINE AT STERLING, VA LTC OFFICE

PHOTOGRAPH 1