PROTOBLAST™
ENGINEERED BLASTING SYSTEMS

Important things you should know when building a Blast Chamber

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Introduction

A Blast Chamber is a vital part of the industrial coatings industry, in the work necessary to bring raw-off-the-mill and fabricated steel to a suitably clean finish, ready to receive a protective coating. In most instances, a "profile' is imparted to the surface to provide a "key" so that the paint film will bond well.

The concept of directing a blast of high velocity abrasive at the object grew from the days when anyone who had a compressor and some form of pressure vessel could direct expendable abrasive to the work. This led to the concept of the Blast Chamber, where the abrasive can be recycled, allowing the reuse of abrasive that would otherwise be wasted and become a too expensive and wasteful system. In this system, the Blast Chamber dust is controlled by proper ventilation, proper lighting allows the operator to see clearly, produce a constant work quality and where blasting can be done 365 days a year without being troubled by rain, dew, etc. This is done with an absolute minimum of manual labour required.

Don't build a rig, plan a system

These words, by American blast equipment consultant A.B. Williams are so true:- "Blast Chambers more than any other piece of equipment tend to be built as a rig with little or no design input other than perhaps having seen someone else's "rig" or from some vague photograph in a sales brochure". "Often with just a little fore-knowledge a chamber can change from an inefficient rig to an effective asset".

With this in mind, this guide has been written however, it is just that – a guide. There are many important aspects which are too difficult to cover, for instance, the type and capability of dust collector fans. You may get someone who will supply a fan capable of 10,000cfm, but this would not suit a Dust Collector which must continue to put out 10,000cfm even when the filter system is partially clogged. Unfortunately, some manufacturers cut corners with equipment which does not perform as expected, or they may fail to tell you about how much the equipment will cost to run. This guide is only a brief outline on the basic design concepts.

It is essential to grasp that each component or system within a blast facility has its effect on the economics of running a Blast Chamber. For instance: poor lighting, poor dust collection or airflow design, will increase blast time on each job. If you take 20% longer to do each job, wear and tear increases 20%, consumption increased 20%, power consumption increases 20%, labour increases 20%, but you will not get any more for the job.

Let us now go over the various systems that are used in a Blast Chamber, the function of each is discussed along with the various types of equipment available for the function listed. It will be noted that for most systems the most effective system is highlighted. This is because generally the cost difference between systems initially is not nearly as great as the cost difference of running those systems.

Blast Hopper Package

1. The Blast Machine

At the heart of a Blast Chamber Facility is the Blast Machine itself. This is a pressure vessel with a means of loading abrasive through an opening in the top. An Abrasive Metering Valve on the bottom allows the abrasive to fall by gravity into the airstream from the compressor in the "pusher line". This in turn travels at great speed along the blast hose to the Blast Nozzle where, because so much air is forced through a comparatively small orifice, the velocity of the air and abrasive increases dramatically and abrasive is expelled at a very high velocity at the work surface.

2. The Remote-Control System

The other element of the Blast Hopper is the Remote-Control System. This allows the operator to start the Blast by means of a valve (known as a deadman handle) strapped to the blast hose near the nozzle. This valve must by law automatically shut the blast machine down if the valve is released, and lock in the off position. The deadman handle actuates a valve(s) on the Blast Hopper which controls the flow of air from the compressor to the nozzle and the release of abrasive from the hopper.

3. Moisture Removal

A Moisture Trap is commonly fitted to the incoming pipework. This, besides removing moisture, will remove a certain amount of oil if present, and it will also remove particles from the air. This is important, as particles in the deadman control valves can cause a malfunction. After the Moisture Trap a pressure regulator is sometimes fitted to control the blast intensity.

Important Note: The temperature of air passing through the Moisture Trap has a direct relationship to the amount of moisture removed; Moisture Traps cannot take moisture out of the hot air; air coolers are available to increase the efficiency of moisture removal. Most grit flow problems are caused by moisture condensing on the internal blast hopper walls.

4. The Blast Machine Cone

The Cone at the bottom of the hopper should have sloping sides approx. 40°-45° to ensure that all abrasive will flow out.

5. The Metering Valve

The kind of Abrasive Metering Valve is important. Many valves are just not suited to use in all abrasives. The best valves have a short abrasive flow path and can be easily adjusted to very fine settings. Too much abrasive can slow blast operation just as much as too little abrasive can.

6. Pressure Loss

Pipework size is highly critical. A guide is that a hopper with 1" pipework will satisfactorily handle up to a 1 ¼ (No. 4) nozzle; although a 5/16" (No. 5) and bigger use Blast Chambers with a 1 ¼" pipework. For high production blasting, 1 ½" is recommended for No. 5 and No. 8 nozzles.

The design of fixed pipework between the compressor and blast hopper is very important with all tee-offs, elbows etc., causing potential pressure loss.

Moisture Traps & Remote-Control Valves must be capable of passing air with minimal pressure loss, ¼” (No 4) nozzles should use at least 1” Moisture Traps and valves. The $^{5}/_{16}$” (No 5) and $^{3}/_{8}$” (No 6) nozzles should use 1 ½” Moisture Traps with large element size and 1 ¼” deadman valves (DO NOT use 1 ½” or 2” Moisture Traps with small elements in this industry). The $^{7}/_{16}$” and ½” nozzles require full flow 2” ported Moisture Traps. We recommend a non-element type, e.g. high volume 50mm moisture separator – stand mount. Care in the selection of Remote-Control Valves is warranted, as many 1 ¼” connections are restricted by small 1” internal passages resulting 5-10 psi pressure loss across the valve itself. We recommend 1 ½” valving where $^{7}/_{16}$” and ½” nozzles are to be used. Air control and metering valves are available with up to 2” air passages where very high air volumes are needed.

7. Hoses and Hose Couplings

Air and Blast Hoses for the incoming air must be large enough. Jack Hammer style (‘Chicago’ type) couplings and hoses to 1” are suitable for up to ¼” nozzles.

Do not use ‘Chicago’ type (Jack Hammer) couplings for $^{5}/_{16}$” nozzles or larger! Surelock (or similar) 1½” couplings and hose are suitable for $^{5}/_{16}$” (No 5) and $^{3}/_{8}$” (No 6) nozzles. Surelock couplings are about two times the size of ‘Chicago’ type couplings and provide very little flow restriction. The 2” Surelock or BOSS Nut & Tail Couplings and hose are ideal for $^{7}/_{16}$” and ½” nozzles (Nos 7 & 8). The Air Supply Hose should never be PVC type hose, as this hose cannot handle the heat and oil which is dangerous. Only premium “synthetic” rubber bull hose should be used. Larger hose diameters should be used over long lengths (16m or more).

Only proper Static conductive blast hose should be used as blast hose. It is recommended that 1 ¼” Standard Blast Hose be used over long lengths and an 8m or 16m 1 ¼” Super Whip (lightweight) hose be used for the last length. Being lighter and more flexible will make for easier blast conditions. **Note:** always use as short as possible blast hose (i.e. do not use 30m of hose if 15m will reach). Not only will you be wearing out blast hose unnecessarily, you will be getting more pressure drop! In general, a blast hose should be three times the nozzle size and a bull hose (the air supply hose) should be four times the size. Whip checks **MUST** be used on all joins to prevent injury in the event of a coupling failure.

8. Blast Hose Couplings

Blast Hose, Couplings & Nozzle Holders. ALWAYS use proper blast couplings, as any normal hose fitting which is not designed for blasting will become unsafe, be sure to check couplings and nozzle holder gaskets regularly. Nozzle gaskets should be 1 ¼” bore for 1 ¼” hose and nozzle entry size and the deadman control hose lines should be strapped to blast hose every 1m. As a guide, ¾” hose may be used with up to a ¼” nozzles and a 1” hose may be used with up to $^{5}/_{16}$” nozzles, always use 1 ¼” or even 1 ½” hose with the larger nozzles.

9. The Blast Nozzle

Blast Nozzles should be "supersonic" Venturi type nozzles made with either tungsten carbide or silicon carbide. **VERY IMPORTANT**: never fit or use 1" entry size blast nozzles on to a 1 ¼" bore blast hose as blast speed will drop dramatically. A 1 ¼" blast hose must have 1 ¼" entry size nozzle fitted. Hint: nozzle wear is easily checked by using an equivalent size drill bit, ($^{1}/_{16}$" is a lot of wear). **NEVER** bash a blast nozzle against the job, the blast pressure should always be measured with a needle pressure gauge behind the nozzle. **NEVER just assume** that because you have 100psi at the compressor or even at the blast hopper that you have sufficient nozzle pressure. Pressure drops of 35psi or even more are regularly found by unsuspecting operators.

10. The Blast Helmet

Blast Helmets and Filters must be approved by all relevant statutory authorities the helmet should also be comfortable and quiet. Regulations require a thick INNER LENS and an outer disposable lens which can be readily replaced. If an inner lens of glass is used a thick plastic lens must be used inside that; so that if the glass shatters the glass cannot injure the operator. Helmet air conditioners are effective in providing cool air to the helmet, air conditioners that both heat and cool are also available.

11. Remote Control System (Deadman System) Speed

A **Deadman system** should react reasonably quickly to the operation of the Deadman Handle. If quick start/stop is required a Thompson Valve system should be installed. This system can include an extra control which allows the operator to stop the flow of abrasive and "blow-down" the job with compressed air from the blast nozzle, then release the deadman which depressurises the blast hopper and allows it to reload. If, due to a long length of control hose, the reaction time is too slow, then an electric over air system may be installed.

12. Communication System

Communication Systems are traditionally cable type units which have been more reliable as they are not affected by static electricity. However, advancements have been made with wireless communication, such as the NovaTalk system which suits the Nova 2000 and the Nova 3 Blast Helmet.

Significant production increases can be realised if the operators can communicate freely with the supervisor without having to put down the blast nozzle to stop work.

The Blast Chamber

13. The Blast Chamber

This section covers some points regarding the layout of the chamber including the air inlet position and air exhaust.

The first consideration that generally arises when discussing a Blast Chamber is the size. Don't make it too big!

The suggestion is that 1.2m clearance each side and above the largest item you need to get into a Blast Chamber is generally considered about right.

The critical thing here to understand is that the width and height, has a direct impact on the cost to establish initially, and **cost to run**. Here's why, if a Blast Chamber of 5m wide x 5m high was built, you will have a cross sectional area of 25m², which means a 21,000cfm Dust Collector would suffice. A 6m wide x 6m high Blast Chamber however requires at least a 30,000cfm. Not only is there a difference in price between a 21,000cfm unit compared to a 30,000cfm Dust Collector there is also a difference in cost per hour to also run. You would get most jobs including semi-trailers into a 5m x 5m Blast Chamber! The suggestion is that you would get 98% of your work into a 5.5m by say, 5.5m high Blast Chamber you will be better off going for that size and doing the other 2% outside or outsource.

The same rule applies to the length, while the length will not change the size Dust Collector required, you will have a large floor area to recover abrasive from, this will add to the cost in the building of the Blast Chamber. The Oscillating Tray Floor type of grit recovery will not make a big difference to the running cost, but if you opted for a pneumatic recovery (Waffle) floor, you will be paying quite a lot more to run the Blast Chamber in electricity bills (refer to Underfloor Recovery Floor section). Of course, if your decision is to have a steel plate floor and manually recover abrasive, you may not want too large a Blast Chamber to sweep.

Many Blast Chambers are built with doors at each end. If you have enough area on your site for this then it is an option worth considering. This option allows you to load the item to be blasted onto a work trolley while blasting is in progress, then while the blasted item moves out the far doors into the paint section, the next item is moved into the Blast Chamber.
This option is of course will influence the location of the abrasive reclaim system and Dust Collector, etc. Generally, doors at each end are built only on the larger Blast Chambers.

Lighting in the Blast Chamber is also critical. The code of practice stipulates a minimum 200 lumens when measured horizontally 1m above the floor. The lighting also effects the productivity of the Blast Chamber as poor lighting will mean there is a much greater chance for the operator to miss spots and therefore time is wasted on re-work.

14. Material Handling

Careful planning is also required regarding the means of handling of items to be blasted in and out of the Blast Chamber.
The following information may assist you with your planning:
Work Trolleys – this is the most common method used. Several trolleys are often provided; rails extend from within the Blast Chamber to outside, and the work is loaded by forklift or overhead crane and the whole item is wheeled into the Blast Chamber. While blasting is in progress, the previous item blasted can be painted while on its trolley, and the next item to be blasted can be loaded onto its trolley. The trolleys often have 20+ ton capacity.

Forklift – except for Blast Chambers with a steel plate floor, it appears from observation over the years that it is better to keep forklifts out of Blast Chambers. The high concentration of weight buckles the grid mesh quite quickly and the ability for the back wheels to "screw" the grid panels out of position has seen many a forklift wheeled through the floor.

Overhead Gantry Cranes – these are sometimes used where the owner feels that he can satisfactorily crane the items to be blasted in. Usually the wire rope passes along a long shot in the ceiling of the Blast Chamber with the gantry passing over the top of the Blast Chamber. Rubber flats along each side of the slot preclude the loss of abrasive. In the majority of cases operators end up using trolleys on rails to wheel the items into the Blast Chamber and the gantry is only used to load the trolleys while blasting is in progress, as it is a slow process.

15. Blast Chamber Construction

Construction Materials – regulations in most states prevent the use of certain materials including masonry, rubber, and sheet roof and walling steels such as corrugated iron, trimdeck etc. Blast Chambers are best made of mild steel plate walls, ceilings, and in the case of non-recovery floor chambers, the floor. Lighter plate is suitable for the ceiling, 5mm for the walls and 10mm is ideal for floors. Generally, it is good to make the Blast Chamber inside a shed or workshop as it makes weatherproofing easier, it also means the blast hopper and abrasive separator can be out of the weather.

Generally, the Dust Collector is sited outside of the building particularly in the case of larger units, although it is quite satisfactory inside. **Important** weatherproofing of the Blast Chamber, including the door areas, the blast hopper and abrasive handling equipment is essential as a very small amount of moisture will clog the abrasive, steel grit particularly will rust into hard lumps. Also bear in mind that once blasted it will be an advantage if you do not need to take the item out into the weather as the smallest amount of rain, dew, etc. will cause a rust "bloom".
Floor grating is for the standard duty Blast Chamber which is typically made of 30 high steel grate panels – heavy industrial Blast Chambers will use 40mm high section grating. It is important that the underfloor support structure be carefully designed to cope with the maximum anticipated weight.

16. Dust Collection

This important item is required by statutory authorities it is an essential component towards making your Blast Chamber efficient. If you find it difficult to see inside a Blast Chamber because of dust, the lighting may be very good, but to be practical each item can and does take longer to do, because you will be going back over areas that have been missed. It is not uncommon for time reductions of 25%, and usually the operator does not realise just how much time he is losing until the problem is rectified.

The two main questions that you will need to be address as to the Dust Collector are:

- What size (capacity) will I need?
- What type of Dust Collector will suit best?

Size of Dust Collector – if we turn back to page 6 when the size of the Blast Chamber was discussed it was noticed that the cross-sectional area was the deciding factor relating to the needed capacity. We used the example of 5m wide x 5m high Blast Chamber with a cross sectional area of 25m. For this we stated a 21,000cfm Dust Collector would be sufficient.

This is calculated using the air velocity of 0.4m/s which is stipulated in the National Abrasive Blasting Code of Practice. This velocity works well with common abrasives such as garnet and steel grit but if using a much dustier abrasive higher velocities maybe be needed.

17. Types of Dust Collectors

Broadly speaking there are two types of Dust Collectors that meet EPA Guidelines. These are: Wet Scrubs type units and Dry Reverse Pulse (usually) element or cloth filter bag. Each type has its pros and cons, some of the features that relate to each type are:

Wet Scrub Type Dust Collectors – can be used with any situation or abrasive. Not to be confused with water spray type units, the wet scrub actually passes the dusty air below water level, literally scrubbing the air, the dust is entrained in the water and after passing a series of baffles etc. nearly all moisture is removed before being exhausted to the atmosphere. It is not uncommon for a very small amount of mist to get through, so generally it is exhausted outside of the building which also keeps noise levels down.

Wet type units can cope with large volumes of dust, because there are no elements to clog and the air flow remains fairly constant which is always important. In other words, the water can become extremely dirty before any appreciable difference occurs. A small amount of detergent added to the water helps prevent solidifying of steel dust in the water. Clean out is easiest if done regularly, and a truck such as one that would suck out industrial water tanks, or septic tanks, makes clean out easier. Manual cleaning maybe be required to get the last portion out.

A wet type Dust Collector fitted with an underwater cooling coil will reduce compressed air temperatures, thus reducing troubles with moisture clogging abrasive in the blast hopper.

The other point about wet type units is that initial purchase price is usually much less than Dry Type Units. Running (power) costs are usually close to the same as dry type units.

Dry Type Dust Collectors – these have been used for many years, in more recent years the reverse pulse units have made these much more efficient. Mechanical shakers have been employed to shake and loosen dust from filter bags when the dust collector is turned off. This is necessary as the fine dust clogs the bag, reducing airflow dramatically.

Reverse Pulse is used in the case of bag type and element type Dust Collectors. A sequential timer activates an air solenoid valve which sends a "shock" of compressed air through the element or bag in the opposite direction to air flow. If the shock is sufficient, dust which has accumulated on the outside will be released and most should fall away, even while the Dust Collector is operating. It is an especially good idea to continue the pulse for a couple of cycles after the dust collector fan is turned off.

Today most Dry Type units use elements not at all unlike large truck type air filter elements (truck type elements are not used as they do not provide the life or level of dust emission standards required). Whichever filter medium is used, the cost of replacement does need to be weighed up as the life of the elements/bag is a significant cost factor. Fines and dust will need to be disposed of regularly and this can be a dusty job.

Dry Type Units are better suited to situations where dust concentrations are lower, hence they are used in Blast Chambers using Steel or Chilled Iron and not where high levels of dust are common from the items being blasted, i.e. from heavily rusted steel etc. Increasing the pulse frequency will help if dust generation is increased.

18. Airflow Within the Chamber

This subject is one of the most important and least understood aspects of the Blast Chambers. Planning the airflow with a chamber should be the next step after determining first the size; the position on the side; then where the Dust Collector is. Here are some tips:

a) The air should enter the chamber at one end and exit the other. If air enters on one long side and exits on the other long side, the speed of airflow will be low, unless you had monstrous or multiple Dust Collectors. If air speed is low, dust will settle on the floor. Next time the blast is pointing in the dusty area you will pick it up again, and again, and you will create your own dust storm. This point cannot be stressed enough.

b) The air inlet vents therefore will be at opposite ends to the dust collector. As it is common for the Dust Collector to be at the opposite end to the doors, the vents frequently are placed in the doors. This has the advantage of not forming 'dead' spots where airflow is low, and dust will settle to the floor. If the vents were in the roof just inside the doors you would have a 'dead' spot where dust would settle just inside the doors. It is usual for vents to be positioned not far above floor level (up to 1m). Additional vents of course may be necessary and can be either higher up or on each side of doors on side walls. The inlet air vents are best made so that air can pass in without undue restriction, (approx. 300m/min) but so that baffles precludes abrasives from passing through.

c) **Exhaust Plenum** – this is located at the opposite end of the Blast Chamber to the inlet air vents. If this unit is located on the end wall 'dead' spots will be minimalised, however, it is sometimes necessary for the exhaust plenum to be on the side wall. If this happens, the corner opposite may form a low airflow 'dead' area. To overcome this, a small additional inlet vent not far up from the floor will overcome this problem.

19. Exhaust Plenum

To lose even a small amount of good abrasive out of the exhaust into the Dust Collector will rapidly make the blast operation costly, therefore the design of the exhaust plenum is critical. Abrasive blasted at the exhaust exit and passing into the exhaust plenum must be deflected and speed reduced so that gravity can allow the particle to drop out and back into the Blast Chamber without the airflow carrying it out and on into the Dust Collector. Hence the exhaust plenum is also a critical element in the whole process of making the blast facility as efficient as possible.

It should be noted that some Blast Chambers utilise the power of the Dust Collector to convey abrasive from "waffles" under the mesh floor to the abrasive separator. The Dust Collector in this case obviously needs to be massive to provide enough air speed to carry steel abrasive along (1100m/min minimum) the underfloor channels. Power consumption (therefore cost) to run this type needs to be evaluated carefully (see: Underfloor Recovery Systems page 13-15). Blast Chambers with Waffle Floors typically have a downdraft airflow, the air entering inlet vents in the ceiling of the Blast Chamber.

Abrasive Elevating & Separation Units

20. Design and Type Considerations

Whether or not your blast facility is going to have a full floor area recovery or just a part of floor area is recovered, the problem remains that you will need to lift (elevate) the grit either before or after it is cleaned (separated) and drop it back into the storage hopper on top of the blast hopper.

Two methods are common in the industry, these are: bucket elevators or pneumatic (airflow).

Of the two, pneumatic is as far as cost to supply the equipment is concerned, a little cheaper. As you have already got a Dust Collector sucking lots of air, why not utilise the airflow? Its advantage is that it is cheaper to supply and install initially.

Its disadvantages are:

- **Velocities** must be high to carry abrasive, i.e. >1100 m/min. Hence wear particularly on bends tends to be high even with wear plates installed.
- **Power** consumption is high, usually this type of elevator is used in conjunction with a full or partial recovery Waffle Floor.
- Such systems are prone to clogging. If airflow drops or if too much abrasive is fed at one time, the weight of abrasive becomes greater than what the rush of air can lift, and it will bog down. Care needs to be taken not to allow this to happen.
- Bucket elevators have the disadvantage of costing a little more initially, but a bucket elevator cannot bog once the flow control gate is set. You will need to replace the buckets every few years depending on usage.

Their features include:

- lower power consumption, usually about 1kw.
- high transfer rate of abrasive (6-9 ton/hour).
- they cannot bog.
- they are quiet.
- low wear and maintenance factor.
- they match in with the 'airwash' separator.

Augers are not used or recommended with abrasives. They are occasionally used by persons who build their own Blast Chamber. Experience would dictate the high wear and being subject to failure due to high mass materials would make them not recommendable. Steel Grit also does not 'flow' like wheat and other grains will.

21. Abrasive Separation

Abrasive Separators – it is necessary at some stage to separate the dust, fines and trash from the good abrasive. In the case of pneumatic recovery this can be done in two ways.
The abrasive is sucked up by the pneumatic pipe to a cyclone type separator, enters at high velocity and spins around the cyclone losing speed and dropping down out of the generally high velocity air area, settled down at the bottom where it is stored until the pop-up valve drops, allowing the abrasive to run into the blast hopper ready to go again. Fines and dust, however, are carried by the flow of air away from the circumference of the cyclone into an adjustable (usually) opening in the centre then on to the Dust Collector.

Once again high velocities are required hence wear is often a problem. Care needs to be taken to make regular inspections of wear plates. Cyclonic separation is used quite a bit as they are really the only way to go if you have pneumatic recovery and work moderately well if care is taken in the adjustment of them. However, a perfect separation is not usually possible; if you attempt to get rid of all unwanted fines you will discover that you also lose an unacceptably high proportion of good abrasive. Another disadvantage with this system is that all dust and fines go to the Dust Collector, which means that you will load it up quicker than you really need.

The other means is to suck the abrasive from the floor into a large plenum chamber where the abrasive is slowed down and falls into a tube running along the bottom. Most of the dust has separated at this point, being carried up high in the plenum chamber because of being finer and out into the Dust Collector. Another suction unit draws the abrasive along the tube running along the bottom and to a cyclonic separator on top of the blast hopper.

The added advantage of this system is that you can achieve a little better level of dust separation. The disadvantage apart from the high wear problems associated with high velocities is that there is a further suction unit consuming a few horsepower to operate. Once again, it is recommended to stop and calculate just how much it will cost to run that few horsepower each year. Electricals can make or break a blast operator.

Air Wash Abrasive Separator/Classifier. This type of unit is often used in conjunction with a bucket elevator. It utilises the 'winnowing' principle; a comparatively gentle flow of air passes through a curtain or 'waterfall' of abrasive, this carries the dust out to the Dust Collector, the fines drop into another drum/skip, and the good abrasive falls into a chute which carries it to the storage hopper on top of the blast hopper. It is hard to think of any disadvantages with this system; wear is low because of the low air velocities, fines are not loading up the Dust Collector, they are falling into a separate skip; but the best thing is that you can achieve a high class of separation. Very little dust will find its way back into the blast hopper reducing dust levels within the Blast Chamber, and you will not be disposing of good abrasive. You can adjust it simply so that you can keep abrasive which has broken up but is still useful or increase the airflow a little and it will return only larger particles to the blast hopper.

This unit is particularly good if you change the type of abrasives in your Blast Chamber, as it can be easily adjusted to suit the different abrasive.

Underfloor Recovery Systems

22. Abrasive Separation

This system is important to the efficient operation of a Blast Chamber. This first thing to comment on is that if you are considering a chamber with no underfloor recovery now, if you wish to upgrade later on you will save heaps by some forethought as to the type, position of various items.

Underfloor recovery systems are installed to recover spent abrasive, convey it to the abrasive separation system and onto storage ready for reuse without any manual labour being required in the case of full recovery, or minimum labour in the case of partial recovery floors.

There are three main types of Recovery Systems used these days.
These are:

1. Pneumatic “Waffle” type floors
2. Oscillating Tray Conveyor floors
3. Sweeper floors, Augers and conveyor belts

Perhaps the first question that needs to be asked is what criteria will help me to decide which is the best for my application? What disadvantages and advantages does each have?

Pneumatic “Waffle” Floors are recommended for use only with the finer grades of steel grit. Chilled Iron grit up to G17 or Steel Grit up to GL40 should be the largest grade used. Garnet will carry satisfactorily with pneumatic recovery. Waffle type floors have several characteristics which are important. They do not require a deep pit, not that there is a big difference between a 500mm pit compared to a 1000mm pit in cost, but in some areas high ground water can be a problem. Pneumatic floors are a little cheaper than some other types generally. Some disadvantages however are that because it is common for quite large quantities of abrasive to collect in the channels it means that it is not practical to change from one abrasive to another. For example, if you commonly used chilled iron grit and won a contract to blast with shot you will be disappointed at the amount of cross-contamination. Or if you had a job which required the use of garnet say on aluminium, you cannot change over without a major problem. For general blast work to get a maximum blast speed you will probably use G12 or GL50, but if you had a contract which required a larger profile and you needed to use G24, you would be surprised how much mixture you will get. In a large Blast Chamber with waffle floor it is common to eventually have several (costly) tonnes trapped in there.

It is wise to consider how much energy costs are going to be. A medium Blast Chamber will require a Dust Collector with at least 10kw; an extra 8-10kw more power is needed to provide enough airflow to carry the abrasive, that’s about $4,000 worth of electricity per year, or $20,000 in 5 years!

Pneumatic recovery is quite commonly used in partial recovery Blast Chambers. Consideration needs to be given to cost to upgrade to a full recovery if needed at a later date, this would necessitate replacing the Dust Collector. Care needs to be taken to prevent small items blocking the abrasive holes at the bottom of each waffle as a blockage means the removal of a grid section and digging out abrasive until the piece can be removed.

Waffle floors do not require daily or weekly maintenance apart from clearing blockages. With time the holes can become worn at the bottom of the waffle. A piece of steel with correct hole size, tack welded over enlarged holes will restore airflow to normal.

Oscillating Tray Conveyors - these conveyors will perform well with all types and sizes of abrasive. They are a "tray" underneath the grid mesh floor and running along the length of the Blast Chamber. They can be anything from 200mm to 2400mm wide and are suspended at regular intervals along each side with special rubber blocks from a base firmly fixed to the floor of the elevator. Rubber mounting blocks have been used for many years; they have the advantage that there are no bearings to wear out. The rubber mounting blocks should be checked annually and may need to be replaced every few years.

The main bearings on the eccentric are very reliable these days and life is dramatically increased. The tray is usually made to a maximum length of about 18m which is adequate for most Blast Chambers. They can be anything from 500mm-1800mm deep. The deeper the pit, the wider the chamber can be with a single tray. If a pit is 1600mm deep with a 1800mm wide tray, the Blast Chamber can be about 5.5m wide. Sloping hopper plates at about 35-40° direct the grit from each side onto the conveyor in the centre.

Generally, the cost to dig and concrete a 1500mm deep pit is not a lot more than a 500-750mm deep pit. For this reason, a decision on whether to use this system is not usually based on any cost difference between this system or others, as the advantages outweigh any savings that could be made with a shallow pit. In high groundwater areas where the pit cannot be too deep, or if very wide Blast Camber is needed, it is customary to use two oscillating conveyors side by side.

If the Blast Chamber only requires one tray and the doors are at one end only, then the oscillating tray simply can convey the abrasive directly into the bucket elevator. A 'live' sieve at the end removes trash before entering the elevator.

The oscillating tray cannot be overloaded; even if someone were to dump a whole tonne of steel grit on the tray it will simply carry to the elevator without any problem. Within a few minutes all of the grit will go through. This means that if you had to change abrasives, the abrasive is simply allowed to drain out of the hopper, clean the ½ shovel full out of the bottom of elevator, clean the top of the blast hopper of abrasive and you are ready to drop the different abrasive on the tray with no cross-contamination. This process usually takes about half an hour.

In the case of the Blast Chamber with two conveyors side by side, the conveyors would carry the abrasive and drop onto a small cross-oscillating conveyor which carries the abrasive across the Blast Chamber to the elevator on one side.

Where a Blast Chamber is too long for one conveyor, it is customary for two conveyors to feed from either end to a cross conveyor running across the middle of the Blast Chamber to an elevator halfway along one side of the Blast Chamber.

Sweeper Floors, Augers, Conveyor Belts

These types are grouped together as they are a form of conveying which is being used less and less frequently. Although they use considerably less power than the pneumatic recovery systems, they have not achieved a reasonable standard of reliability, with broken cables, sweepers, augers, when jams occur. High wear due to the scraping action and dust in the bearings are common. Tales of successful floors are the exception rather than the rule. Bear in mind that to be successful, a floor should not require undue labour to upkeep, the aim with recovery floors is to reduce that labour required to recover abrasive to nothing if possible.

It should always be remembered that abrasives are just that, abrasive. As well, abrasives generally don't 'flow' with sweepers or augers alike, for instance grain will. These floors do not lend themselves to change from one type or grade of abrasive to another, as considerable quantities are left behind.

Compressor & Air Supply Equipment

23. Compressors

This section is not intended to deal with the various forms and types of compressors, more what the air requirements are for abrasive blasting and how we can get the compressed air to the nozzle.

The first point to note here is that generally a Blast Chamber operator will find an electric powered compressor more practical and cheaper, as the refueling and maintaining of a diesel motor is quite an undertaking. Where power supplies are limited however, it can sometimes be necessary.

The next point is probably more important. Except where abrasives are being used which must not be used at high pressure (i.e. plastic media, glass beads, stone fruit kernel or shells) pressure plays an important part in the efficiency of a blast operation. Generally, blast pressures should be around 100psi (70kpa) mark, MEASURED AT THE NOZZLE. The pressure reading at the compressor or even at the hopper may give little idea as what is happening at the nozzle.

Why is the nozzle pressure important? And why measure at the nozzle? Isn't what the pressure gauge on the hopper reads near enough? If my compressor is showing 120psi what more could you ask for?

These and many similar questions are asked every day. The first rule of thumb here is to understand that for every 1psi increase in air pressure over 80psi you will gain 1.5% more production. This doesn't sound a real lot, but if you increase 10psi and do get a 15% rise in production, you will get 8 hours blasting done in 7 hours. That is 1 hour less labour for 1 (or maybe 2) workers, 1 hour less running for the compressor (that is quite a saving), 1 hour less running time on the Blast Chamber and ¾ hour less abrasive consumption (you will break the abrasive up a bit quicker). That sure adds up, doesn't it?!

Going back to the nozzle pressure then, we understand that finally it is the pressure at the nozzle that gives air, and therefore the abrasive particles, the velocity we need. Refer to section 1 where we covered essential items such as blast hose, blast hopper pipework, moisture trap sizes, and also, we spoke about the "bull hose", the hose from the compressor to the hopper.

A well set up Blast Chamber compressed air supply will have full size fittings on the compressor if the compressor is greater than 250cfm 2" (50mm) minimum size threads full bore ball or stop valves, 2" hosetails. For 175 cfm to 250cfm, 1 ½" (40mm) is suitable size thread and hosetails.
The hose from the compressor should lead to an air cooler unit, or in the case of a wet type Dust Collector, air cooling may be achieved by means of a steel coil below the water level. An air receiver tank is not essential and plays little part in a successful blast operation, except that it usually will help a little if you do not have adequate air cooling. Bear in mind that all this should be in correct sized pipe fittings.

24. Air Coolers/Driers

Air coolers take two main forms, refrigerated units and heat exchange units. Refrigerated units are good, they cost quite a bit both to buy and run, but almost invariably are very successful.
The other type is essentially a heat exchanger which looks a bit like an overgrown radiator with air blown through by a fan. These are successful enough, but the best types have a double heat exchange system; after it has cooled the air, removed the moisture in the moisture trap, the air is reheated; this type is very successful. The relative humidity drops dramatically when reheated and moisture is not a problem. **Important Note:** any moisture trap will not perform as it should if the air passing through is too warm. Nearly all abrasive flow problems can be traced to moisture.

After the air has passed through the cooler/drier it may be piped to the blast hopper. If the air is cooled in a wet type Dust Collector, a moisture trap should be installed either on the blast hopper or nearby. It should not be necessary to have a further moisture trap if you have an air cooler/drier system, it only will increase the pressure drop unnecessarily.

Getting back to our questions then, we ask, why measure at the nozzle? The reason is because often the fittings, automatic valves and even blast hose that is too long/too small in the bore size will account for significant pressure drops. Always measure the pressure of the air as it comes out of the compressor (always push needle through hose at about 45° and in direction of airflow). Then measure pressure behind the nozzle. Total pressure drop should be 5-8psi maximum. This usually means the optimum pressure is obtained when the compressor is delivering 105psi plus, measured when, and only when, the blast is in operation.

Abrasives

25. Different Abrasive Types Explained

Many types and grades of abrasives have been used and need to be used in a Blast Chamber. While the following guide is not exhaustive, it may help to put abrasives into perspective.

Steel Grit and Chilled Iron Grit – this abrasive is by far the most commonly found blast medium in Blast Chambers, and for good reason. These abrasives can be recovered and re-used many times over and they will produce almost no dust.

Steel being more malleable will tend to round over and break up less and produce approx. 25-50 cycles (these figures can vary greatly depending on pressure and what the abrasive is hitting). Usually the blast speed is slower however, as the abrasive rounds off.

Chilled Iron grit is cheaper (about 10%), is more common and the blast speed is achieved with **finer, not coarser,** grades. The exception to this is when very tough high build coatings etc. have to be removed.

Coarse grades are produced not so much for people to go faster, generally they won't, but because the specification calls for higher blast profile. Generally, then, for normal structural steel work, the best and most economical grade is G-12 or G-17 may be used if a greater profile is required. If you use larger grades than these to get a profile required, it is most likely that you have an equipment (nozzle pressure) problem.

Steel and Chilled Iron are especially suitable for Blast Chambers with full recovery floors and most partial recovery floors. If you have a steel plate floor it can be a problem to sweep and shovel if your recovery system is a long way down the chamber. Generally, steel and chilled iron grit is not to be used on aluminium, etc. as it can leave impregnations on soft surfaces.

Garnet – Fast becoming the preference for most Blast Chamber applications, this versatile abrasive can be used on nearly every surface. Very fine grades produce excellent results on lighter alloys (care always needs to be used to ensure buckling does not occur) while premium grades produce excellent profile and cleaning standards on virtually all surfaces. Blast speeds are generally higher than with steel abrasives. It is used quite extensively in Blast Chambers where there is no full floor recovery system because it is easier to shift than steel grit. It can be recycled up to 6-10 times (depending on blast pressure) and while it will produce more dust than steel it is still considered a relatively "low" dust abrasive, which does not leave everything filthy. With a proper abrasive separator, dust levels should remain low even after many cycles.

Aluminium Oxide – Also a relatively "low" dust abrasive, this product will recycle several times more than garnet and will produce a good blast profile and cleaning standard. Being much more expensive however, it is not commonly used in Blast Chambers.

Glass Beads – Mostly used in cabinets, this product is not used a lot in Blast Chambers. Used at lower pressures (50psi approx.) it can be recycled 10-20 times. It is used for low aggression applications requiring no profile and will produce a kind of polished effect. Can be used on cars, aluminium, etc. Larger grade sizes are used for peening and deburring.

Copper Slag – Not used in Blast Chambers, as it has limited recyclability. It is very high dusting requiring a large dust collector, and results in a poor blast finish. This abrasive has specific uses in outdoor blasting (where allowed) requiring an expendable abrasive.

Plastic Media – Excellent on sensitive surfaces but slow – mainly used for surfaces such as aircraft wings etc. where low aggression is required without stressing metal substrates. Can be used on cars with excellent results but because of cost and low blast speeds is not common. Special equipment required.

Walnut shell, Stoned Fruit Kernel etc. – These blast mediums are being used successfully more and more on items such as cars where low aggression media is required. Cheaper than plastic media, it produces quite good results, but special equipment is required.

Steel & Chilled Iron Shot – This product is used in a small number of cases of Blast Chambers where large castings are to be blasted. It is far more common in 'airless' blast operations. Shot, which is spherical steel or chilled iron is commonly used to clean up castings, removing the casting flash, foundry sand and peening the surface in one operation. Because it doesn't produce a sharp profile it is not common for use on structural steel, although if the kind of profile is not important; it can be if not too large a grade is used. Larger grades are typically used in peening operations.

Granulated Perspex etc. – These products have evolved as the popularity of low aggression blasting has increased. In some cases, quite good results are achievable, care being needed to evaluate each product.

Most abrasives function acceptably, but not all are economical. It is better to pay three times more for a product that produces more than three times the result. For instance, if you get four times the life and the same blast speed, you'll be better off. Also, you may be better off paying three times as much for a product that only gives you one and a half times the life, but one and a half times the blast speed; remember **your running costs per hour is most likely to be greater than abrasive consumption (cost) per hour.** This is true of all abrasives, and probable ranks as the least understood aspect of the abrasive blast industry.