AVE Vacuum Degassing

Technical Overview

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Typical materials that can be degassed:

- RTV Silicone Rubber
- Araldite
- Polyester Resin
- Pastorals
- Casting Plaster
- Polysulphide Rubber
- Polyurethane Resin
- Adhesive Mixes
- Epoxy Resins
- Investment Plaster

Vacuum Degassing Overview:

When any of the above listed materials are mixed with the required additives, accelerators, filler etc., then air bubbles can become trapped within the mixture. If not removed before the material cures the air bubbles can cause defects such as nodules, cavities and hollows in the finishes cast. With electrical and electronic encapsulation then these air bubbles can cause electrical breakdown. On intricate castings additional work will be required to correct the defects caused by the air bubbles.

All Epoxy Resins, Araldites, Silicone Rubbers as well as any other mixed materials to be degassed will expand during the degassing process. It is essential that a container of sufficient volume is used. It is not uncommon for materials to expand two to six times their initial volume while degassing. As the bubbles burst at the surface the expansion decreases. This process can take several minutes depending on the viscosity of the material, the speed of the vacuum pump and the volume of the vacuum chamber.

Do take heed of both the viscosity and the pot life of the materials to be degassed. Materials with a very high viscosity will take a lot longer. Some very high viscosity materials will be very difficult to degas. If the pot life is short, then speed could be essential.

If you are unsure of the properties of your materials, then a few simple tests will help:

- Mix a small sample and without degassing see how long it remains fluid. That is essentially the pot life.
- Put a small sample in a container in the vacuum chamber and while closely observing through the lid see when the surface of the material starts to bubble. Use the vacuum isolation valve to stop pumping as soon as the first bubbles appear. Make a note of the pressure shown on the pressure gauge. Some materials will start to degas at quite high pressures – in excess of 50 Mbar. Some materials will also seem to outgas for a very long time. This could be due to the pressure being too low and some of the volatiles in the material being evaporated off. The vacuum should only be held for a short period once bubbles are seen at the surface of the mixture, otherwise the chemical structure will be altered and curing time, so care should be taken with such materials to degas at a pressure which removes the air but does not start to evaporate the material or constituent parts of that material.

Once you are satisfied and confident the materials you are using are not going to cause problems then proceed.

Remove the vacuum chamber lid. Ensure that both the vent and vacuum isolation valves are closed and switch on the vacuum pump to warm up. A warm pump is more efficient and handles condensable vapours better.

Measure out the required amount of material together with any hardeners or fillers into a clean bucket of adequate size to allow for expansion. Mix well, either by hand or with an electric mixer.

Place the bucket in the vacuum chamber and replace the lid. Gently open the vacuum isolation valve. Some light hand pressure on the lid may be required to establish a good seal – you will see on the gauge when the pressure starts to fall indicating a seal has been made.

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Observe the surface of the material. Once bubbles start to come to the surface and break close the vacuum isolation valve. If the bubbles subside after a short time open the valve again. Repeat that process so that you progressively pump the chamber down.

If there is a rapid rise in the level of the degassing material close the vacuum isolation valve and allow a little air back into the chamber with the vent valve. That will 'collapse' the degassing material and will break a lot of the surface air bubbles. Continue pumping down and by balancing both the vacuum isolation and vent valves it will be possible to degas quite volatile mixes.

Once you are satisfied the material has been degassed close the vacuum isolation valve, open the vent valve and remove the chamber lid. You are now ready to use your degassed material.

This degassed mixture is then poured into the mould taking care to minimise any trapped air. When the mould has been filled it can be placed into the vacuum chamber and evacuate as before. This time there should be minimum air bubbles breaking the surface which was trapped in undercuts or from the surface of the mould. Please again beware of boiling off the volatile components of the mixture and only a few seconds should be required at full vacuum.

A few important things:

- **NEVER** allow degassing material to top the container you are using.
- **NEVER** allow any acetone-based solvents to be in contact with the chamber lid. The lid can be damaged or destroyed by such solvents.
- **ALWAYS** use either a disposable or a cleanable container within the chamber.
- **ALWAYS** check both the level of oil in the vacuum pump and the condition of that oil. If the oil is particularly cloudy it is time for an oil change. Degassing processes are quite hard on vacuum pumps so change the oil regularly. Oil is a lot cheaper than a pump service, or a replacement pump! If changing the oil make sure the pump is hot before draining and NEVER use solvents of any kind as a flushing agent. If you need to flush the pump, use only clean vacuum pump oil.

Common Causes of Bubbles in Castings:

- Air trapped in moulds
- Volatile components in the mixture rising to the surface when under vacuum.
- Air from mixing of resins and hardeners.
- Gases generated from the curing process.
- Solvent vapours from cleaning or certain mould release agents.
- Moisture or contamination in the mixture

Factors That Affect the Removal of Gases:

- High viscosity
- Heating the material can help reduce the high viscose materials, but consideration should be given to the effect on the pot life before heating any mixed materials.
- Larger, faster vacuum pumps.
- Ultimate final vacuum pump pressure
- Stirring under vacuum
- Volume of mixture being degassed