ARMCON

How to make your own moulds

– using Armpol

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Introduction
This guide is intended to provide the first time or inexperienced user of Armpol's two component polyurethane systems with information to help ensure that the materials are being handled and processed correctly.

It covers hand mixing of solid and foamed two component polyurethane systems.

It does not attempt to be exhaustive, and for more specific information please contact our technical staff on 01625 856685.

The Two Component Material
The cans or drums in which you receive your materials will be labelled with the product type, (Polyol blend, prepolymer etc), together with its product code. Please ensure this code corresponds with the Product Information sheet being referred to.

The Polyol Component
The polyol component is a blend of various polyols, catalyst, pigment and also perhaps fillers, foaming agent, flame retardants, thixotropes etc.

As received, the polyol drums are well sealed. Besides preventing leakage of liquid, this seal also prevents the ingress of atmospheric moisture. This absorbed moisture can lead to bubbling or foaming in the final product. When handling the polyol blend, minimise the opportunity for moisture pick-up by replacing bungs immediately after use and not leaving material exposed to the atmosphere.

The polyol blend, being a mixture of various materials, may freeze out or separate. Consult the data sheet, under 'Storage and Handling' for the recommended conditions of storage. If freezing of the polyol is suspected (lumpy or granular appearance), then the polyol should be warmed until the contents are restored to a free flowing liquid state.

Also as the polyol component may contain fillers, or other components that separate, it is necessary to mix the polyol blend before use. An effective way of performing this is to roll the keg or drum, most efficiently on a drum roller. Five minutes or so rolling should be sufficient for most systems.

Ensure polyol is liquid and fully mixed, prior to removing any material from the drum. The material to be used should then be brought to processing temperature - see data sheet.

NB If any material is removed from a polyol container when the material is in a frozen or unmixed state, this will probably result in the remainder of the drum being

reject, as the balance of the components within the polyol has been upset.

The Isocyanate Component
The isocyanate component is not usually a blend, but it is recommended that the data sheet for the product be checked before use.

Isocyanates do react with atmospheric moisture and the same precautions to minimise contact with moisture should be taken as with the polyol blend. Isocyanates may freeze if the minimum storage temperature is not maintained (see Product Information Sheet).

Having read the various data sheets previously referred to, you will be aware of the vapour hazard which can occur when handling isocyanates, particularly at elevated temperatures. If higher processing temperatures are required, then for hand mixing it is recommended that only the polyol is heated, with the isocyanate at ambient temperature, or the operation done with sufficient air extraction to remove any potential vapour hazard.

PROCESSING THE TWO LIQUIDS
This is a simple technique suitable for most materials where there is sufficient pot life to handle the processing and casting operation. Usually a 'gel time' of at least 5 minutes is required for this operation.

Calculate the weight of material required for the casting operation, making an allowance for wastage in the mixing vessels, using the weight ratio given on the Product Information Sheet.

The polyol/isocyanate, whichever is the larger quantity, should be weighed into the vessel. The required amount of co-reactant is then weighed into the same vessel, in the correct weight proportion. The accuracy of this weighing should be to within $\pm$ 1%.

The two liquids are then ready to be mixed together. For small quantities (up to about 5 kgs) this is easily accomplished using a broad bladed spatula (or by use of a high shear mixer for foamed materials, blending the two liquids thoroughly together, paying attention to material on the sides and base of the vessel. The mixing process will take around 1 minute or a little less with practice. For larger quantities, a mixer attached to a power drill can be effective. A purpose designed mixer known as a "Jiffy" mixer is obtainable in various sizes for mixing volumes of 10 litres upwards, (consult Armcon Limited).

After mixing, the mixed material should be decanted into a second container of approximately double the volume of liquid being used and a further quick mix given. This technique avoids any chance of unmixed material on the sides of the first container finding its way into the final moulding.

THE MOULDING PROCESS

The mixed material can be poured, or injected into the pre-prepared mould.

The mould itself can be made from various materials, see General Information Guide 3.

The mould should be released using a suitable release agent - normally wax or silicone based.

Specialist release agents such as wax/silicone blends and PTFE based materials are available, consult Armcon Limited for details.

After preparation, the mould should be heated to the temperature required. This will vary depending on the particular polyurethane system being moulded (refer to Product Information Sheet).

After pouring the polyurethane into the mould, it should be left for sufficient time such that the polyurethane is strong enough to be demoulded without deformation. If post curing is required (normally stated on Product Information Sheet) this is best carried out as soon as is possible after demoulding. It may be necessary to use a former in order to maintain the shape of the item during post-curing.

GUIDE TO MOULDMAKING USING POLYURETHANES

Polyurethane systems can be simply processed and cast onto a variety of substrates to form polyurethane moulds. A basic method is described below.

Mould Construction and Preparation

Mould Box

The mould box can be made of metal, wood, GRP, polyurethane or other plastic.
If the mould box is made from wood or other porous material, all surfaces coming into contact with the polyurethane should be sealed with Formlac or ArmSeal to obtain a glazed surface.
The mould box should be leak proof and preferably have detachable sides to
facilitate demoulding.

Master Pattern
The master pattern again can be made of metal, wood, GRP or polyurethane or other plastic. Again, if the master is porous it should be sealed as the mould box, above.
If there is any chance that the master could float or move it should be fastened to the mould box base by screwing or glueing.
There should be no air voids between the bottom of the master pattern and the base of the mould, as these could vent into the mould-making material due to pressure generated by the heat of reaction. Any voids must therefore be filled or chance of pressure build up nullified by drilling a small hole through the mould box base to vent the void.

Release Agents
When mould boxes and masters are new, a generous coat of release agent should be applied. A heavy coat of wax release agent followed by a light coat of silicone release agent is recommended.

Wax release agents tend to seal residual porosity in surfaces and can be applied in a thick layer without affecting the moulding surface but give matt moulded surfaces. However they tend to build up deposits fairly quickly in moulds and do not give as easy a release as silicones.

Silicone release agents applied in thin coats (thick coats tend to give surface defects on the moulding - pinholing effect), give good release, do not build up quickly in moulds and give a glossy surface. They are however, very difficult to remove totally from the final moulding and can give problems if the item is required to be painted or bonded. Wax is much easier to remove in this respect and should be used whenever post painting or bonding is necessary.

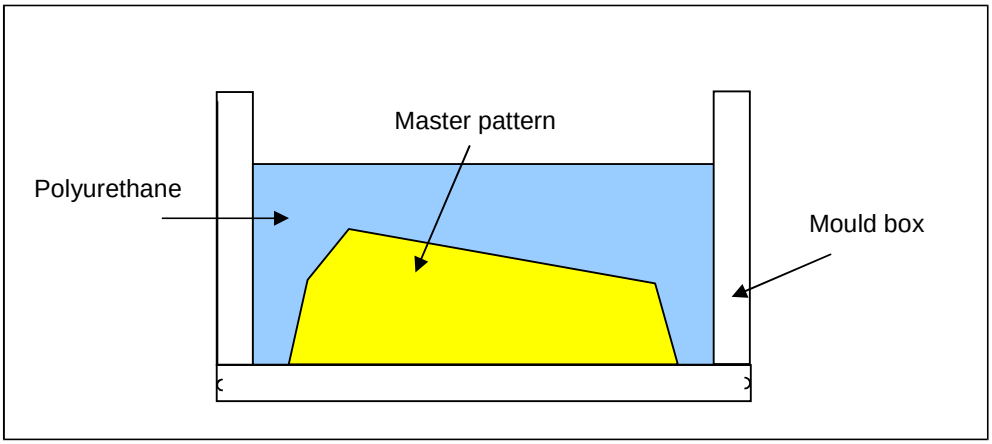
Silicone release agents in aerosol form can travel long distances in the workplace and cause severe problems if painting or bonding operations are being carried out in the same area. In these cases liquid, brush on release agents should be used.

Tolerances
If final dimensional tolerances are critical, allow for shrinkage in the mouldmaking and subsequent moulding operation. As a guide, polyurethane will normally shrink between 0.5 and 2% linearly during cure, (contact our Technical Department for advice.)

Effect of Temperature
Before casting the polyurethane into the mould box, the box and master, if made from conductive material, may need warming. This speeds the demould and prevents surface defects known as “shrinkage marks.” The box should then be set level prior to pouring the polyurethane into it.

Mould Preparation
The details will vary according to the item to be moulded but typical moulds are made as follows:

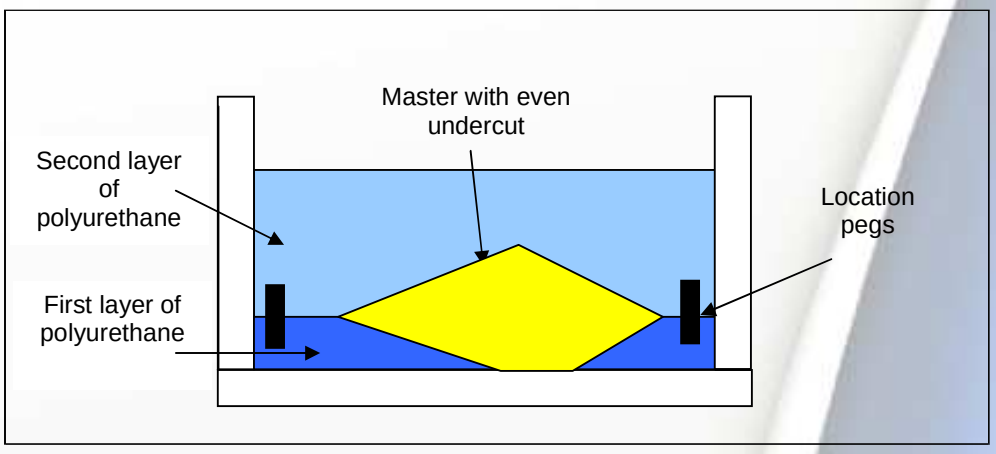
One part moulds:



- Master and mould box coated with release agent.
- Polyurethane is mixed and poured carefully over the master to reduce air entrapment.
- Allow to gel.
- Demould item.

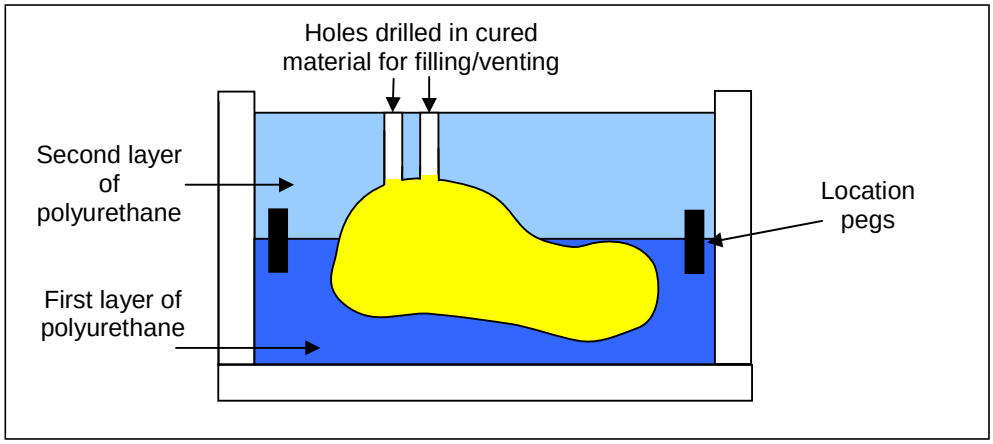
Other Mould Designs
Depending on the design of the master, different mould designs may be necessary:

Two part Open Top Mould



After mould and master preparation, pour first layer of polyurethane to level of undercut on master.
Position location pegs in first layer. Allow first layer to gel. Then apply release agent to surface of first layer and pour second layer of polyurethane to cover master. A simple two part open top mould is the result.

Two part closed mould



Prior to pouring the first layer of polyurethane, the released master can be suspended in the mould box or rested on spacers made from the same polyurethane as the mould making materials (spacers should be totally free of release agent otherwise they will not bond to the poured on polyurethane).

The box should then be filled to the split line and allowed to gel, then the surface coated with release agent. Location pegs should be incorporated to ensure accurate location of the two mould halves.

The second layer of PU can then be poured to cover the master. After demould, holes can be drilled in the mould to facilitate filling and air venting during the filling operation.

Note: The pouring of the various layers of polyurethane for mould making should follow on quickly from each other, before shrinkage has occurred on the previous layer.

More complicated, multi-part moulds can be made by adaptation of the techniques described. Further advice can be obtained by contacting Armcon Limited.

Materials Handling and Processing (See General Information Guides 1 or 2 for more details).

The polyurethane materials should be brought to the processing temperature (consult data sheet for details).

The polyol drum should then be rolled or the contents thoroughly mixed by some other method to ensure the polyol blend is homogeneous. If hand mixing, the components should then be accurately weighed into a vessel suitable for mixing the two components together (i.e. + or - 1% max on either component). Components must be measured by weight, not by volume, as volumetric measurement is unlikely to have sufficient accuracy.

The components should be mixed together thoroughly using a spatula blade or for larger quantities (5kg upward) a 'Jiffy' mixer may be used. Mixing normally takes 30-60 seconds.

Unmixed material is likely to be present on the sides and base of the vessel and for this reason, the material should be transferred to a second container and given a further brief mix (unmixed material, if present in the moulding, will be visible as wet or soft streaks).

The liquid mix can then be carefully poured into the mould box until the liquid level is the required height above the master to give sufficient thickness of base to the mould. During pouring ensure that turbulence is minimised (turbulence can incorporate air bubbles) and that the liquid level rises fairly evenly, giving good flow over the mould surface.

The material should then be left to gel and acquire sufficient strength to demould. It may be necessary to take one or more sides off the mould box to facilitate demoulding. After demould, the mould should be left to cure, either at room temperature or more rapidly in an oven at up to 70℃. The mould should be well released with silico ne or wax release agent before use.

PROBLEM SOLVING

If the materials are handled and processed in accordance with the Product Information Sheets and general instructions given little or no difficulty should be experienced in producing satisfactory mouldings. However, from time to time problems occur.

A list of possible faults and likely causes of those faults in given below:-

1) **Polyurethane does not harden fully - remains soft, soggy or cheesy thoughout the whole bulk of moulding.**

Likely Cause

- Materials mixed at incorrect ratio.
- Polyol insufficiently mixed before use.
- Isocyanate frozen of excessively cloudy (clouding caused by moisture absorption, or by being out of shelf life).
- Mould temperature too low.

2) Solid polyurethane contains bubbles in final moulding.

Likely Cause

- Air trapped in mixture.

Bubbles will be visible in the liquid before gellation, and will tend to rise to the top surface. More careful mixing or vacuuming of the materials required.

- Moisture contamination of system.

Absorbed into polyol from atmosphere or damp mixing vessels etc. Liquids when mixed together look bubble-free to start with, then bubbles start to appear during reaction before gellation. Depending on extent of contamination can vary from a slight rash or surface bubbles, to a foamy mass. Protect materials from atmospheric moisture.

- Solvent contamination of system when machine dispensing.

When materials start to heat up during reaction, solvent will boil causing bubbles. Can occur where solvent flushing valve on machine mixing head is leaking.

- Materials of ratio.

If a gelling material contains excessive isocyanate this can cause voids in the mouldings. They will be primarily in the centre of the moulding and be relatively large.

3) 'Leaf' or 'fern-like' pattern on outside surface of mouldings (shrinkage marks).

Likely Cause
- Mould temperature too low.

4) Soft or wet streaks in otherwise good moulding

Likely Cause
- Insufficient mixing of the two components together.
- Scraping unmixed materials off the mixing vessel sides into the mould.

5) Soft patch or patches in otherwise good moulding.

- Occurs on machine cast mouldings where there is an uneven surge of materials into the mixing chamber . This can occur on start of pour, or cyclically on piston pump machines.

6) Course cell structure (foams).

Likely Cause
- Insufficient nucleation air - reduced expansion.
- Insufficient shearing of nucleation air in mixing chamber - reduced expansion.
- Incorrect ratio - polyol rich - reduced expansion.
- Incorrect ratio - iso rich - over expanded hard foam.

7) Pin-Holes in surface of mouldings.

Likely Cause
- Excessive use of silicone release agent.
- Moisture contamination of polyurethane (cf observation 2) or moisture on surface of mould.
- Porous mould surface.
- Air dispersed in mix.

The extremely wide range of polyurethane materials available from Armcon Limited, and the equally wide range of uses, often necessitates specialist advice, please call for further advice.

POLYURETHANE PROCESS CHECKLIST

PREPARATION

Check that:

- Appropriate product information and Health & Safety date sheet are available and understood.
- Both components are fully melted out and at recommended processing temperatures.
- Both components are fully blended
- Moulds/masters are correctly sealed.
- Moulds/masters are correctly coated with release agent and heated if necessary.

MOULDING:

Ensure that:

- Both components are accurately weighed.
- Drums are re-sealed after use.
- Both components are fully mixed.
- Second mixing vessel is used. Mixed material is transferred and remixed.
- Vacuum is applied to remove entrapped air (NOT required for foam systems).
- Mixture is poured carefully into mould.

POST TREATMENT:

- Clean mixing equipment.
- Remove moulding from mould**.**
- Post cure moulding where applicable (see Product Data Sheet.)