PLASTICS CONSULTANCY NETWORK

Gas Assisted Moulding

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Gas assisted moulding has been commercial now for a number of years. There are several approaches to the process technique which has many benefits to offer.

What is It?

The process consists of the introduction of gas at pressure to the inside or to the surface of a moulded part. This replaces plastic volume with a gas induced void. On the face of it, this may be seen as a blow moulding technique it is not. There are a different set of rules and constraints to both part design and the actual process. It can be used to improve the aesthetic appearance of a part by the removal of sink marks but, more importantly, the application of internal gas pressure can remove part distortion - totally. This aspect of Gas Assisted Moulding is least well understood. The concept of the hollow handle has been readily grasped along with the large plastic volume reduction in the cavity.

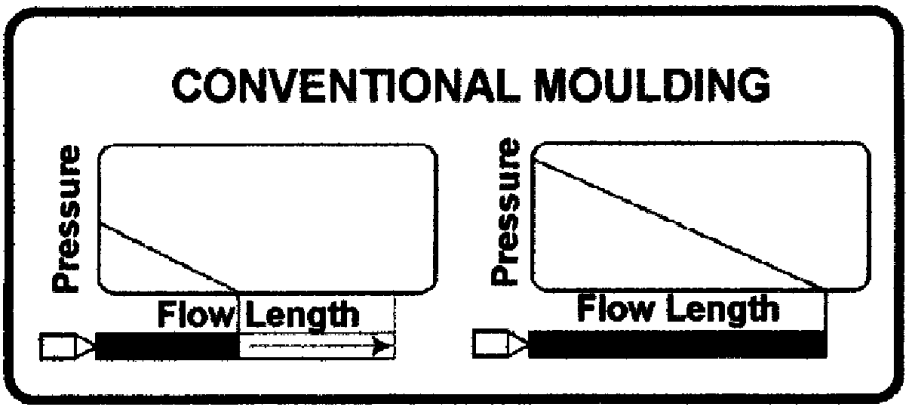
Much has been written on the patents surrounding the process. A recent count showed that there are around 800 to date. Not all are applicable in every market of the world. Many compromise the position of others and some do not really affect general use. Some processes require registration and an applicable license fee. Others do not.

Gas and Compact - How do They Differ?

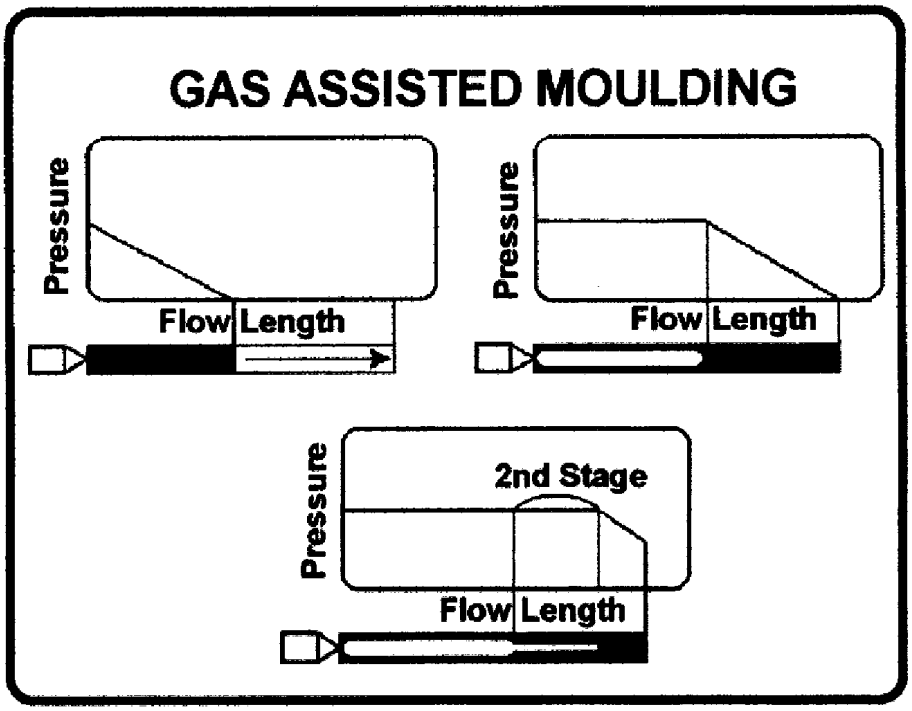
With conventional moulding, the flow length for a given wall thickness depends upon the pressure applied. More pressure generates more flow.

This can be seen in the diagram that the flow length is proportional to the applied pressure. The force applied is at the feed point and over the whole area of the part.

A higher lock force is then needed to stop the mould being opened.



Gas assisted moulding allows the extra flow from the use of the internal gas pressure which replaces some of the cavity volume with a gas generated void.



The initial introduction of pressure to push the melt mass into the cavity, can be much lower as the final pressurisation required to both fill and pack the mould is then provided by the gas pressure.

This applied pressure is the same wherever the gas bubble reaches.

The overall pressure to the cavity is thus much less than is needed by compact moulding.

As the melt cools and contracts, the gas pressure takes up the volume reduction and extends into the melt and creates a secondary penetration. This then reduces the visible sink marks and takes out the part distortion caused by post moulding contraction. The issue that helps create distortion is the pressure variations occurring within the moulding as the part cools in the mould. The pressure variation across the part from a high at the gate to a low at the flow extremity, creates distortion. Gas pressure equalises this pressure so that wherever the gas bubble has reached, the pressure is always equal. This pressure equalisation reduces the distortion effect caused by pressure deviations.

The other contributing factor to part distortion is cooling rate. Plastics are self-insulating and do not easily give up their heat. As the part thickness increases, the time for the core to reach room temperature increases proportional to the square of the thickness. The gas bubble intervenes and effectively reduces the section thickness and the effects of the cooling time. This is most noticeable in the handle type applications where section thicknesses can easily exceed 25 mm.

Process Limitations

There are two basic processes in gas assisted moulding:

1. Filling the mould using gas pressure
2. Packing the mould using gas pressure

The amount of gas volume used is process dependent;

- 40% of cavity volume is gas in the filling mode
- 10% of cavity volume is gas in the packing mode

When filling the cavity using gas pressure, the gas "bubble" has to have somewhere to go. As a result, the gas channel cannot be extended right to the part's extremity. Should the design be such, then the gas will blow through the bubble if too little plastic remains at the flow front or, if too much, then a very thick mass of plastic will take a long time to cool. Striking a balance is the important thing. When gas is introduced into the part, the gas travels much more quickly than the plastic which can lead to the blow through if insufficient plastic remains at the flow front.

Packing the mould using gas pressure has same limits on what is reasonably possible.

In broad terms, it is not easy to get gas into a section thickness under a 3 mm wall.

It is possible by using very high gas pressures and early injection of gas to get into this thickness but it is hard work and may not be finally productive. Gas distribution channels can be added to facilitate the flow of gas. However, this translates into plastic distribution channels which are emptied when the gas pressures displaces the central core.

Gas, if left to its own devices, will go wherever it finds the easiest path. It will always chase the low-pressure flow front and go via the thickest or hottest part of the moulding. So, it is very important to give the gas direction by means of flow channels. They are to encourage flow along a chosen path by design rather than allowing the gas to find its own path.

It is not always possible to get a perfect fill with the "short shot" method. In some cases, other techniques may be required to get perfect results. These include the use of overflow wells or using the "pushback" method of putting the gas pin at the flow extremity, and then pushing the excess material back into the barrel through the gate and runner.

Gas moulding has come a long way in a relatively short time. The knowledge base is expanding rapidly and results get better all the time. However, it should be remembered that a bad design will still be a bad design, even with gas assist to improve the parts. Well-designed parts with the as process in mind will always generate good results.

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