Abstract Title: Production of composite mouldings

There is provided a method of making a composite moulding, that includes placing a reinforcement material and a spacer medium 12 into a mould 1, 2, introducing a resin into the mould 1, 2 so that it permeates the reinforcement material and introducing a gel coating material into the mould 1, 2 so as to coat the spacer medium 12. A reactive resin is injected through inlet 6 and reactive gel coat is injected into port 13. The reinforcement material and the spacer medium 12 may be introduced in the mould 1, 2 at the same time (as a pack 11) or may be introduced separately.

Resin entry and at least its partial curing may precede injection of gel coating, though their entry at the same time or the entry of the gel coating before the resin are also possible.

The spacer 12 may be textured. A material to maintain a gel coat gap, separate from the spacer 12, may be partially or fully soluble or insoluble in the presence of the gel, as may the spacer 12.

The spacer 12 may be surface treated for adhesion to the resin and the coating.
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(58) Field of Search:
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FIGURE 3

Moulding stage 3
FIGURE 4
Moulding stage 5

FIGURE 5
PRODUCTION OF COMPOSITE MOULDINGS

Field of the Invention.

This invention relates to the production of composite mouldings.

The composite moulding industry is continuously seeking ways to reduce chemical vapour emissions of resins and of gel coating materials into the environment in an ever-increasing attempt to fulfil continued tightening global legislation requiring reduction of the emission of volatile organic compounds. The legislation includes Directives 1999/13/EC (The Limitation of Emissions of Volatile Organic Compounds due to the Use of Organic Solvents in Certain Activities and Installations) and 2004/42/EC.

Currently composite closed mould production methods, e.g. resin infusion, resin transfer moulding (RTM), Light RTM and low pressure press methods, dramatically reduce emissions during the moulding cycle whereas open moulding processes continue to be the primary source of emission concern. Thus, closed mould processes are gathering greater use over open mould applications due to the legislation requirements.
When there is a need to produce a gel-coated composite moulding with either an open or a closed mould process, there still remains the need to spray or brush apply the gel coat, in an open environment, onto the mould prior to moulding with resin and glass to complete the process. For closed mould processes, this gel coating method produces a high emission of volatile organic compounds similar to that of the open moulding method.

An object of the present invention is to provide an improved method of producing a composite moulding having a gel coat.

A more specific object of the present invention is to provide a method of applying a gel coat surface to a part within a closed mould when the mould is closed and thus reducing emissions to a far lower level than has previously been possible.

Summary of the Invention

According to a first aspect of the present invention there is provided a method of making a composite moulding that includes placing a spacer medium within a mould, placing a reinforcement material in the mould, introducing a resin into the mould so that it permeates the reinforcement material and introducing a gel coating material into the mould so as to coat the spacer medium.
The spacer medium may be non-porous and non-permeable or semi-permeable.

The spacer medium may comprise a textured film or may comprise a film that has had a surface treatment to enhance its adhesion to the resin and the gel coating material.

The spacer medium and the reinforcement material may be introduced into the mould separately or as a reinforcement pack.

The reinforcement material may be sandwiched between two layers of the spacer medium.

Depending on the mould geometry, one or more inlets for the introduction of each of the resin and the gel coating material may be provided. These may be situated at the centre, edge or elsewhere on the surface of the mould, or a combination of these. Vents and/or vacuum take-off points may be situated anywhere in the mould geometry, as required.

In addition, any inlet/outlet pipes may be introduced from the opposite face of the spacer medium. For the gel coating material, an inlet pipe or vent may be provided feeding through the reinforcement material and the spacer medium into a gel coating material cavity.
Introduction of the resin into the mould and at least partial curing thereof may be effected prior to introduction of the gel coating material into the mould.

Introduction of the gel coating material into the mould may alternatively be effected while the resin is being introduced into the mould.

As a further alternative, the gel coating material may be introduced into the mould prior to introduction of the resin into the mould.

The gap or cavity for the gel coating material may be maintained by one or more of:-

a differential pressure between opposed faces of the spacer medium,

the use of a textured film as the spacer medium – the textured surface may be soluble, partially soluble or insoluble in the presence of the injected gel coating material,

the use of a material designed to maintain the gelcoat gap that is separate from the spacer medium – this material may also be soluble, partially soluble or insoluble in the presence of the injected gel coating material, and

the presence of an incompressible liquid, such as the gel coating material.
According to a second aspect of the present invention there is provided a composite moulding made by the method defined above.

Further features of the invention will be apparent from a consideration of the following detailed description of one example thereof with reference to the accompanying drawings, Figures 1 to 5 of which show successive stages of a moulding operation.

The method of the present invention is primarily designed for use with rigid or semi rigid matching closed mould sets as commonly used for composite reinforced glass fibre moulding production. In particular, but not exclusively, it focuses on use with the RTM and Light RTM processes. Examples of other possible injection processes include Vacuum Infusion (VARI), CCBM, VARTM, RIFT, SCRIMP, RFI and the like.

In the example light RTM process shown in the drawings, a matched pair of closed moulds is used comprising a face mould 1, which will be used to mould the cosmetic face of the component and will also be the moulding surface from which the external seen gel coat face will be moulded, and a matching contra-mould 2, which is positioned and vacuum-clamped to the face mould 1. Seals 3 and 4 in the contra-mould 2 provide mould cavity vacuum security. The mould vacuum is drawn from a central point 7 via a resin catch-pot 8 having a sealed lid 9 and a vacuum connection 10.
A dry reinforcement fibre pack 11 is tailored to fit the mould cavity between the mould 1 and the contra-mould 2. The fibre pack 11 includes a layer of reinforcement material, such as glass or other fibres, and a spacer medium, which may comprise a double-sided fibrous/textured film 12 that comprises an impervious plastic film and fibres projecting from the film on both sides thereof. The film 12 is thus, in this example, a fibrous/textured film. A reactive resin is injected into the mould injection point 6 and preferentially flows around the mould flow channel 5. The fibre pack 11 is permeable to the resin flow that, due to a positive pressure difference between the flow channel 5 and the final exit point 7, continues to flow towards the exit point 7. Any excess resin is caught in the catch-pot 8. The flow of resin is then stopped and the reaction gels and hardens.

Due to the fibrous/textured nature of the film 12, the resin permeates the fibres projecting from the impervious film and, when the resin is cured, the film 12 is mechanically bound to the moulded part including the resin-cured fibre pack 11. As shown in the drawings, the film 12 is the lowermost component of the fibre pack 11.

There is a cavity 15 between the upwardly presented face of the mould 1 and the underside of the film 12 and this cavity 15 is maintained during the above moulding operation. The cavity 15 may be only 0.5 mm in thickness but it is nevertheless a calibrated even cavity which, if an impermeable spacer medium is used, is vented to atmosphere.
A secondary moulding operation now proceeds to fill the open thin cavity 15 by first drawing vacuum on outlet 16 and pressure-injecting a suitable reactive gelcoat resin into port 13. Flow channel 14 preferentially allows this resin to circumnavigate the mould cavity 15 whereby it flows towards exit 16 via the empty cavity 15. The gelcoat resin can be pre-pigmented (or non-pigmented) and will have suitable rheological and cure characteristics appropriate to the specific process. It may have different qualities as compared to that of the resin used to fill the glass pack 11 in the previous injection, gel and cure cycle. It is also designed to be of a quality such that it is suitable to provide the external moulded part with appropriate aesthetic and durability characteristics.

Due to the film 12 having a fibrous/textured surface on its underside and present in the thin cavity 15, it becomes mechanically bound to the new reactive second injection resin as it gels and cures to a hard finish before the mould set is opened.

Once the gelcoat resin has hardened, the mould set is opened and the finished part removed. Further edge trimming is carried out and, if required, exit sprue points are de-nibbed providing the finished moulded part.

The cosmetic resin gel coat surface is thus mechanically bound to the main fibre-reinforced structure via the film barrier that is now
moulded into the entire product at a fraction of a millimetre below its surface.

Advantages of the zero emission gel coat process described above are as follows:

1. It provides a zero emission method of in-mould coating a fibre-reinforced product.

2. It will reduce the potential for cosmetic defects on the gel-coated surface, (caused, for example, by shrinkage of the main moulded part) if the gel coat is applied as a secondary step after the main moulded part has cured and shrunk.

3. It provides the possibility of applying a completely different cosmetic gel coat surface to that of the resin system for the main reinforced moulded part. For example, a phenolic moulded part can now be moulded with a high quality polyester cosmetic coloured gel coat. Also an epoxy moulding can be provided with a highly chemically resistant vinyl ester gel coat.

4. It lowers the cost of the current gel coat

5. It reduces the risks of associated problems when applying gel coat finishes as a first stage to moulding as
   a) it eliminates excessive gel coat thickness,
   b) it eliminates porosity to a higher degree,
   c) it eliminates gel wrinkling phenomena,
   d) it reduces the gel coat curing time,
   e) it reduces osmosis, and
   f) it provides more compliant gel coat back-up and thus reduces “star crazing”.
6. It eliminates the requirement for highly qualified staff to place the gel coat on the mould face.

7. It provides a path to full automation with in-mould machine surface coating.
Claims:

1. A method of making a composite moulding that includes placing a spacer medium within a mould, placing a reinforcement material in the mould, introducing a resin into the mould so that it permeates the reinforcement material and introducing a gel coating material into the mould so as to coat the spacer medium.

2. A method as claimed in Claim 1, in which the spacer medium and the reinforcement material are introduced separately into the mould.

3. A method as claimed in Claim 1, in which the spacer medium and the reinforcement material are introduced into the mould as a reinforcement pack.

4. A method as claimed in any one of the preceding claims, in which one or more inlets for the introduction of each of the resin and the gel coating material are provided.

5. A method as claimed in any one of the preceding claims in which the reinforcement material is sandwiched between two layers of the spacer medium.

6. A method as claimed in any one of Claims 1 to 5, in which introduction of the resin into the mould and at least partial curing
thereof is effected prior to introduction of the gel coating material into the mould.

7. A method as claimed in any one of Claims 1 to 5, in which introduction of the gel coating material into the mould is effected while the resin is being introduced into the mould.

8. A method as claimed in any one of Claims 1 to 5, in which the gel coating material is introduced into the mould prior to introduction of the resin into the mould.

9. A method as claimed in any one of Claims 1 to 4, in which a differential pressure is maintained between opposed faces of the spacer medium.

10. A method as claimed in any one of the preceding claims, in which the spacer medium is non-porous and non-permeable or semi-permeable.

11. A method as claimed in Claim 10, in which the spacer medium comprises a textured film.

12. A method as claimed in Claim 10, in which the spacer medium comprises a film that has had a surface treatment to enhance its adhesion to the resin and the gel coating material.
13. A method as claimed in any one of Claims 1 to 4, which includes the use of a material separate from the spacer medium for maintaining a gap within the mould cavity for receiving the gel coating material.

14. A method of making a composite moulding substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

15. A composite moulding made by the method claimed in any one of the preceding claims.
**Application No:** GB0623010.6  
**Examiner:** Monty Siddique  
**Claims searched:** 1-14  
**Date of search:** 2 February 2007

**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

<table>
<thead>
<tr>
<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
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| X        | 1 at least         | EP0431729 A2  
(BROOKGEM LTD) impregnating reinforcing glass fibre mass with resin and curing inside a mould, forming a gel-coat in the mould and incorporating one or more films; entire document |
| X        | 1 at least         | JP10286835 A  
(YAMAHA HIROSHI) fibre reinforced plastics-impregnated layer 5, substrate layer 6 and gel-coat layer 7; abstract and drawing etc. |
| A        | 1                  | JP07137043 A  
(HITACHI) film, gel coat etc. |
| A        | 1                  | JP59095111 A  
(KOTOBUKI & CO LTD fibre reinforced plastics with gel coat layer and film |
| A        | 1                  | JP56079096 A  
(YAMAHA) resin impregnated fibrous mass, gel coat and film etc |

**Categories:**

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<td>Document indicating lack of novelty or inventive step</td>
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<td>Patent document published on or after, but with priority date earlier than, the filing date of this application.</td>
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**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

B5A  
Worldwide search of patent documents classified in the following areas of the IPC

B29C  
The following online and other databases have been used in the preparation of this search report

WPI EPODOC