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(54) **PROCEDE DE FABRICATION DE SURFACES AMELIOREES DE PIECES MOULEES EN NON-TISSES**

(54) **PROCESS FOR MAKING IMPROVED SURFACES OF MOLDED PARTS MADE OF NONWOVEN FABRICS**

(57) The invention concerns a process for producing surface-finished molded parts consisting of nonwoven fabrics by coating, in which the coating of the surface(s) of nonwoven fabric molds to be finished is carried out with a duroplastic resin or resin/hardener mixture in conjunction with a lamination and the parts thus produced are heated to temperatures that are above the melting point and above the start temperature of the hardening reaction of the duroplastic resin used and cooled after the coating has hardened.

Abstract

The invention concerns a process for producing surface-finished molded parts consisting of nonwoven fabrics by coating, in which the coating of the surface(s) of nonwoven fabric molds to be finished is carried out with a duroplastic resin or resin/hardener mixture in conjunction with a lamination and the parts thus produced are heated to temperatures that are above the melting point and above the start temperature of the hardening reaction of the duroplastic resin used and cooled after the coating has hardened.

Process for Producing Surface-Finished Molded Parts Consisting of Nonwoven Fabrics

The invention concerns the production of molded parts made of nonwoven fabrics based on natural and/or synthetic fibers, in which at least one of the flat surfaces, usually the exposed side, is finished with a coating, in particular by a high-grade lamination.

Molded parts of this type are used, *inter alia*, in the automotive industry.

Molded parts consisting of nonwoven fabrics are flat moldings made with a duroplastic resin, in particular nonwoven fabrics solidified with phenolic resin or epoxide resin, especially consisting of reused fibrous material.
To produce it, fibrous material and resin powder are mixed together, formed into a fleece and, if necessary, prehardened (presolidified). In flat sheeting, the hardening takes place immediately after the fleece formation in the oven or the presolidified fleece is cut into sheets and hardened by applying pressure in heated compression molds while being shaped. The molded parts are then stamped (*cf.* Kunststoff-Handbuch [Plastics Manual], Vol. 10 "Duroplaste" [Duroplastics], Hanser Verlag, 2nd edition (1988), pp. 763-775). The surface finishing can take place during the hardening of the nonwoven fabrics or in a second, separate step.

During lamination, the subsequently visible surface structure, the laminating material, is bonded with the fleece molding now

serving as a support base with aid of thermoplastic adhesives (hot-melt adhesives) or with special contact adhesives. In the coating process, pigmented, thermoplastic substances in the form of paste or consisting of solutions are applied.

In an improved process, a powdery, thermoplastic mixture having a low melting viscosity is sprinkled on the surface of the laminating material, melted by reheating and then cooled. A uniform coating is thereby formed on the surface of the lamination.

The disadvantage of this process is that the restoring forces of the laminating material are often stronger in the hot state than the adhesive force of the hot-melt adhesive. This results, in particular in geometrically complicated parts, in defects at which the laminating material breaks loose from the base. The loosening effects occur increasingly in those molded parts that are exposed to frequent temperature fluctuations or intensive solar radiation.

Thus, the object of the invention is to provide a process for surface finishing of nonwoven fabric moldings that, although technically similar, can be carried out simply and elegantly like the aforementioned melt-coating process in which, however, the disadvantage of the loosening effects is not given.

The object is solved by a process according to claims 1 to 10, as well as by the nonwoven fabric moldings that are produced according to one or more of these claims.

It was found that a high-grade surface finishing of nonwoven fabric moldings is also obtained when duroplastic resins or

resin/hardener mixtures, that have not as yet hardened and are adhesive-free at room temperature, are used as adhesive for the lamination. Laminating material provided with adhesives of this type is applied to the prefabricated nonwoven fabric or to molded parts consisting of nonwoven fabrics and the article thus obtained is heated to a temperature that is above the temperature at which the hardening reaction of the resin or the resin/hardener mixture starts.
The duroplastic resins thereby harden like a film which bonds with the surface of the nonwoven fabric during the hardening reaction and a flat, irreversible bond results which also does not lead to loosenings at extreme differences in temperature or solar radiations.

This is surprising to the extent that the melting viscosity of duroplastics is generally higher than that of thermoplastics and the applied hardening temperature is substantially above the melting temperature of the thermoplastic binding agents used thusfar and, as a result, the restoring forces occurring in the molding tool during the release of pressure are substantially higher than when using thermoplastics.

Duroplastic resins are usually brittle. Therefore, it is a further surprising effect that the laminations coated with duroplastic resins according to the invention remain stable and do not chip off also when being rolled up or shaped.

A further advantage of the process according to the invention lies therein that the surface finishing of nonwoven fabric moldings can take place both thereby that the duroplastic resins or resin/hardener mixtures, not as yet completely hardened, can be applied both to the prefabricated fleece moldings and also to the laminating material. Moreover, in

this embodiment, it is also possible that, in the contact area, the duroplastic resins used for the surface finishing cross-link with the resins used as binding agent for the textile fibers. This is especially the case when the same or resins that react with one another are used both for binding the fibers and for surface finishing of the molded parts.

A further advantage is that the stability of the molded parts is increased by the cross-linking reaction in the contact area.

Therefore, according to the invention, the duroplastic resin or resin/hardener mixture and a laminating material is applied to the surface(s) to be finished of prefabricated molded parts and the units (articles) thus obtained are heated to temperatures that are above the melting point and above the start temperature of the hardening reaction of the duroplastic resin. After the duroplastic resin has been hardened, the surface-finished parts obtained are processed further in a known manner.

The entire manufacturing process is further simplified thereby that a duroplastic resin, resin/hardener mixture and a laminating material is applied to the surface(s) to be finished of prefabricated or prehardened nonwoven fabrics. The parts (articles) thus produced are heated under pressure and while being formed at temperatures that are above the melting point and above the start temperature of the hardening reaction of the resins used in the coating and above the start temperature of the resins used as binding agent in the fleece. The binding agent in the fleece and the resins in the coating thereby harden simultaneously and, if the binding agent in the fleece and the resins of the coating are identical to one

another or can react with one another, these duroplastics are cross-linked in the contact area.
After hardening of the coating and the binding agent in the fleece, the parts obtained are processed further in a known manner.

With the surface finishing in conjunction with a laminating material, the following various processes are possible:

- The duroplastic resin or resin/hardener mixture is applied to a nonwoven fabric not as yet thermally treated or presolidified and heated to a temperature that is above the melting temperature but below the start temperature of the hardening reaction of the resin. The resin is thereby melted and distributed to form a thin layer. The laminating material is thereby applied either directly or after an intermediate cooling and reheating to this layer and the product thus produced is subsequently, perhaps during forming, heated to a temperature above the start temperature of the hardening of the resin and cooled after hardening of the duroplastic resin and processed further in a known manner.

- The duroplastic resin or resin/hardener mixture is applied to the laminating material and heated to a temperature that is above the melting temperature but below the start temperature of the hardening reaction of the resin. The resin is thereby melted and distributed to form a thin layer. The laminating material thus provided with adhesive is applied either directly or after an intermediate cooling and reheating to a nonwoven fabric that has not as yet been thermally treated or

presolidified and the product (article) thus produced is subsequently heated, perhaps during forming, to a temperature above the start temperature of the hardening of the resin and cooled after hardening of the duroplastic resin and processed further in a known manner.

- The duroplastic resin or resin/hardener mixture is applied to a completely hardened and preformed nonwoven fabric mold and heated to a temperature that is above the melting temperature but below the start temperature of the hardening reaction of the resin. The resin is thereby melted and distributed to form a thin layer. The laminating material is applied to this layer either directly, or after an intermediate cooling and reheating, and the product thus produced is subsequently heated to a temperature above the start temperature of the hardening of the resin and cooled after hardening of the duroplastic resin and processed further in a known manner.

- The duroplastic resin or resin/hardener mixture is applied to a laminating material and heated to a temperature that is above the melting temperature but below the start temperature of the hardening reaction of the resin. The resin is thereby melted and distributed to form a thin layer. A completely hardened and preformed nonwoven fabric mold is applied to this layer, either directly or after an intermediate cooling and reheating, and the product thus produced is subsequently heated to a temperature above the start temperature of the hardening of the resin and cooled after hardening of the duroplastic resin and processed further in a known

manner.

In the first two variations, it is advantageous to use, as duroplastic resin, a resin for the coating that can be hardened with formaldehyde, in particular a novolak that is free of hardeners or a novolak modified without hardeners if the binding agent in the nonwoven fabric is a mixture consisting of a resin that can be hardened with formaldehyde and a substance releasing formaldehyde in heat, more or less a novolak hexamethylenetetramine mixture. The formaldehyde released during hardening of this binding agent is sufficient to also harden the novolak melted to form a thin layer.
A further advantage of this embodiment is that formaldehyde emissions are thereby substantially reduced during production.

The following preferred embodiments result thereform:

- A laminating material provided with a duroplastic resin or resin mixture that can be hardened with formaldehyde as adhesive is applied in a continuous production as endless sheeting to the prefabricated or presolidified nonwoven fabric containing a resin that can be hardened with formaldehyde and a resin releasing formaldehyde in heat and the article obtained is then hardened under pressure at a temperature that is above the start temperature of the hardening reaction of the binding agent used in the nonwoven fabric and that of the adhesive, whereby the formaldehyde being released during the hardening reaction of the binding agent is used as hardener for the adhesive. A completely hardened sheet product is thereby obtained from which plates are stamped or cut to the desired size.

- A laminating material provided with a duroplastic resin or resin mixture that can be hardened with formaldehyde as adhesive is applied in a continuous production as endless sheeting to a presolidified nonwoven fabric containing a resin that can be hardened with formaldehyde and a hardener releasing formaldehyde in heat or only a prefabricated nonwoven fabric and the article obtained is then tempered at a temperature that is above the melting temperature of the adhesive and, in the event that a nonwoven fabric is used that has not been presolidified, above the melting temperature of the resin used as binding agent and then cooled and subsequently stamped or cut to size. The stamped or cut article (semifinished product) is then hardened under pressure and while being formed at a temperature that is above the start temperature of the hardening reaction of the binding agent used in the nonwoven fabric and that of the adhesive, whereby the formaldehyde being released during the hardening reaction of the binding agent is used as hardener for the adhesive.

- Alternatively, a laminating material provided with a duroplastic resin as adhesive that can be hardened with formaldehyde is applied in a discontinuous production in cut form to the prefabricated or presolidified and cut nonwoven fabric containing a resin that can be hardened with formaldehyde and a hardener releasing formaldehyde in heat and the article obtained is then hardened at a temperature that is above the start temperature of the hardening reaction of the binding agent used in the nonwoven fabric and that of the adhesive, whereby the formaldehyde being released from the hardening reaction of the binding agent is used as hardener for the

adhesive.

The pressure applied in this process is of the same order of magnitude as applied to date in corresponding processes according to the prior art.

To laminate nonwoven fabric molds, preferably, a laminating material provided with a resin/hardener mixture as adhesive in cut form is applied to a hardened and formed molded part consisting of nonwoven fabric and the article obtained is heated to above the start temperature of the hardening reaction of the resin/hardener mixture.

The lamination of prefabricated and hardened nonwoven fabric molds has the advantage that a shorter thermal treatment is necessary for hardening the thin layer of duroplastic resin than for hardening a textile fleece. This makes it possible to use products having a lower thermal stability as laminating material.

For the process according to the invention, the same fibrous material can be used that is also used to produce conventionally finished nonwoven fabric molds. Essentially, this is reused fibrous material resulting from the reprocessing of textiles and consists primarily of cotton or polyester fibers, but usually also contains other fibers such as e.g. wool, jute, flax, sisal, polyamide and acrylic fibers. The fibers can contain known additives such as e.g. softening agents, finishings, fungistatic substances or water-repellent agents. Similary, inorganic fibers can also be used as fibrous material.

The presolidified nonwoven fabrics or the nonwoven fabric

molds are also produced in a known manner, as described, *inter alia*, in Kunststoffhandbuch [Plastics Manual], Vol. 10, "Duroplaste" [Duroplastics], pp. 766 to 768.

All flat structures such as e.g. high-quality fleeces, knitted and woven fabrics can also be used as laminating materials as used to date for laminating nonwoven fabric molds, insofar as they are sufficiently temperature-resistant so that they are not damaged at hardening temperatures of the duroplastic resins.

In principle, all adhesive-free, duroplastic resins or resin/hardener mixtures as well as mixtures containing these resins and perhaps hardeners with resins modified in a known manner are suitable for binding the laminations. Examples for these hardenable resins are epoxide resins, unsaturated polyesters, aminoplast, formaldehyde, melanin formaldehyde, melanin phenol formaldehyde or phenol aldehyde resins as well as combinations of these resins with one another or with other modified resins, in particular with 5 - 50% flexiblizing resins such as e.g. polyvinyl butyral, polyvinyl alcohols or phenoxy resins. Phenol formaldehyde resins are preferred.

The direct coating of nonwoven fabric molds, non-hardened or presolidified nonwoven fabrics or the laminating materials takes place according to known processes, by dispersion, roller, smoothing, casting, dipping or spraying processes using suitable pastes, aqueous dispersions or solutions in organic solvents.

The preferred coating takes place according to the powder process. The duroplastic resins or the resin/hardener mixtures in the form of finely ground powder are thereby

applied to the surfaces to be coated. Resins or resin/hardener mixtures are especially suitable for this, the melting viscosity of which is so low during the subsequent heating that the base is suffiently wetted. The preferred melting viscosity, measured at 175°C, is less than 1000 mPas. During this brief heating above the melting point of the duroplastic resin, preferably by means of infrared heaters, a thin, sealed film of the resin or resin/hardener mixture forms on the textile fleece or laminating material, said film cooling quickly and thus becoming solid and adhesive-free.
In the next procedural step, the nonwoven fabric and laminating material are joined together according to one of the aforementioned processes and bonded together using pressure and temperature. The molded part obtained is then cooled and processed further in a known manner.

Example 1

The duroplastic resin used in the example for surface finishing is a phenolic novolak modified with 10% phenoxy resin, having a melting point of 70°C and a melting viscosity, measured at 175°C, of 420 mPas.

Due to aerodynamic fleece formation, an even harder textile fleece is produced having a content of 25% phenolic novolak hexamehtylenetetramine as binding agent (basic fleece).
An optically high-quality fleece (40 g/m^2) (cover fleece), coated with a thin layer (20 g/m^2) of the modified phenolic novolak on one side, is added to this nonwoven fabric and fixed to the basic fleece in an oven by means of heat (75°C). The fleece thus laminated is then subjected to a forming and hardening process in a 180 - 220°C hot tool. So much formaldehyde is thereby released from the

hexamethylenetetramine present as hardener in the basic fleece, that the thin phenolic novolak layer present on the inner side of the laminated cover fleece is also hardened. A textile fleece mold having a layer that is duroplastically bonded and finishing the surface is produced. A clear reduction of formaldehyde emission is found to be a further advantage of this procedure.

Example 2

The duroplastic resin used in Example 2 for surface finishing is a phenolic novolak modified with 10% by weight of phenoxy resin, having a melting point of 70°C and 6% by weight of hexamethylenetetramine.
This finally ground resin/hardener mixutre is sprinkled on a hardened and formed textile fleece mold in a thin layer and heated to above the melting temperature. An optically high-quality needle fleece is applied to this coated textile fleece mold. The high-quality fleece is fixed with high flexibility to the textile fleece mold by means of a remeltable thin film.

In a second procedural step, the thin coating is hardened by means of temperature and pressure that is above the start temperature of the hardening reaction of the resin (90s at 150°C).
This procedure enables the surface finishing with laminating material that has a lower thermal stability than in Example 1. A further advantage of this embodiment is that the duroplastic binding agent in the fleece and the duroplastic resin used for the surface finishing can have a different chemical structure and different chemical cross-linking reactions.

Example 3

The duroplastic resin used in Example 3 for surface finishing is a phenolic novolak modified with 10% by weight of phenoxy resin, having a melting point of 70°C and 6% by weight of hexamethylenetetramine.

This finally ground resin/hardener mixture is sprinkled on one side in a thin layer onto an optically high-quality needle fleece and heated to above the melting temperature of the resin. A prefabricated, hardened textile fleece mold is applied to this coated fleece. The high-quality fleece is fixed with high flexibility to the textile fleece mold by means of a remeltable thin film by quick cooling.

In a second procedural step, the thin coating is hardened by means of temperature and pressure that is above the start temperature of the hardening reaction of the resin (90s at 150°C).

Patent Claims

1. Process for producing surface finished molded parts consisting of nonwoven fabrics by coating the surface(s) to be finished with a laminating material or a duroplastic coating substance, characterized therein that a duroplastic resin or resin/hardener mixture, adhesive free at room temperature, is used as adhesive.

2. Process according to claim 1, characterized therein that a laminating material, provided with a duroplastic resin as adhesive that can be hardened with formaldehyde, is applied in a continuous production as endless sheeting to the prefabricated or presolidified nonwoven fabric containing a resin that can be hardened with formaldehyde and a hardener releasing formaldehyde in heat and the article obtained is then hardened under pressure at a temperature that is above the start temperature of the hardening reaction of the binding agent used in the nonwoven fabric and that of the adhesive, whereby the formaldehyde being released from the hardening reaction of the binding agent is used as hardener for the adhesive.

3. Process according to claim 1, characterized therein that a laminating material, provided with a duroplastic resin as adhesive that can be hardened with formaldehyde, is applied in a continuous production as endless sheeting to the presolidified nonwoven fabric containing a resin that releases formaldehyde in heat or nonwoven fabric that is only prefabricated, and the article obtained is then tempered under pressure at a temperature that is above

the melting temperature of the adhesive and, if necessary, above the binding agent used in the nonwoven fabric, then cooled and subsequently stamped and cut to size, the stamped or cut article is then hardened under pressure and while being formed at a temperature that is above the start temperature of the hardening reaction of the binding agent used in the nonwoven fabric and that of the adhesive, whereby the formaldehyde being released from the hardening reaction of the binding agent is used as hardener for the adhesive.

4. Process according to claim 1, characterized therein that a laminating material, provided with a duroplastic resin as adhesive, is applied in a discontinuous production in cut form to the prefabricated or presolidified and cut nonwoven fabric containing phenolic resin and hardener and the article obtained is then hardened at a temperature that is above the start temperature of the hardening reaction of the binding agent used in the nonwoven fabric and that of the adhesive, whereby the formaldehyde being released from the hardening reaction of the binding agent is used as hardener for the adhesive.

5. Process according to claim 1, characterized therein that a laminating material provided with a resin/hardener mixture as adhesive is applied in cut form to a hardened and formed molded part consisting of a nonwoven fabric and that the article obtained is heated to above the start temperature of the hardening reaction of the resin/hardener mixture.

6. Process according to one of the claims 1 to 5,

characterized therein that the resin used as an adhesive is a hexamethylenetetramine-free novolak.

7. Process according to one of the claims 1 to 6, characterized therein that the resin used as adhesive is a modified phenolic resin.

8. Process according to claim 7, characterized therein that the resin used as adhesive is a phenolic resin modified with phenoxy resin.

9. Process according to one of the claims 1 to 8, characterized therein that the resin or resin/hardener mixture is applied to the laminating material in powder form.

10. Process according to claim 9, characterized therein that the melting viscosity of the resin or resin-hardener mixture, measured at 175°C, is less than 1000 mPas.

11. A molded part consisting of nonwoven fabrics made according to one or more of the claims 1 - 10.