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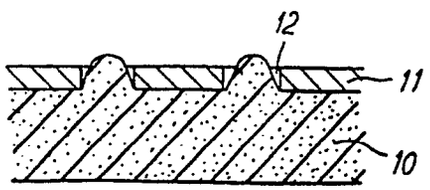
(54) Abrasive foam material and its method of preparation.

(57) To produce scouring pads and the like a stencil 11 is pressed against an open-cell foam sheet 10 so that the foam projects through holes 12 in the stencil, a hardenable resin is applied and upon removal of the stencil and hardening of the resin forms dots embedded in the surface. The foam can be laminated to a fabric backing and the dots may be bonded to the backing. A thin thermoplastic film on the working surface allows use of weak foam material without interfering too much with the abrasive action.

FIG. 1



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ABRASIVE FOAM MATERIAL AND ITS METHOD OF PREPARATION

The invention relates to a foam polymeric material with an abrasive surface, which can be used, for example, to make scouring and cleaning pads for domestic use, and to a method for producing the material.

According to the invention in a first aspect there is provided a method for providing an abrasive surface on a sheet of a compressible foam polymeric material, comprising the steps of arranging a stencil having a multiplicity of holes against a surface of a sheet of a compressible foam polymeric material, applying pressure to the stencil to impress it into the sheet of foam material, applying a hardenable resin to the surface of the stencil remote from the sheet of foam material, the resin contacting the foam material in the region of the holes in the stencil, removing the stencil and allowing or causing the resin in contact with the foam to harden.

According to the invention in a second aspect there is provided a sheet of compressible foam polymeric material provided with an abrasive surface, the abrasive surface comprising a multiplicity of distinct regions of hardened resin which is, at least in part, incorporated in the sheet.

The resin is preferably incorporated into the sheet of compressible foam material in the region of the holes in the stencil and does not project from the surface of the sheet. The foam material is preferably of the "open-cell" type, i.e. a foam material in which neighbouring cells communicate with each other, and the resin, which can contain an abrasive substance, is preferably applied in such a way as not to fill the cells of the foam material. The resin coating

thus hardens the cell structure in the regions in which it is incorporated but should not create a continuous hard surface which closes the cells at the surface. It is however likely to reduce communication between the cells of an open foam structure in the region in which it is incorporated. Since the body of the foam sheet remains unaltered it will absorb the cleaning fluid and supply it to the hardened abrasive regions.

Hence the sheet of foam material is provided with a pattern of regions of hardened resin which do not adversely affect the flexibility of the foam sheet. The resin, being impregnated in the foam material, is unlikely to become separated from the sheet of foam material. Since the resin is applied in a multiplicity of distinct regions it is less likely to crack than if applied as a continuous superficial coating.

The invention will be further described by way of example and with reference to the accompanying drawings, in which :-

Fig. 1 is a section through a sheet of compressible foam polymeric material and a stencil used in a method according to the invention; and

Fig. 2 is a section through the sheet of foam polymeric material shown in Fig. 1, provided with an abrasive surface by a method according to the invention.

In the drawings is shown a sheet of compressible foam plastics material 10 which is of the "open-cell" type in which neighbouring cells communicate with each other. The foam sheet is preferably of polyurethane although there are many alternative materials, for example various rubbers, plasticised P.V.C., modified cellulose. A typical polyurethane foam material has the following characteristics:-

Density	:	15 to 45 kg/m^3
Hardness to B.S. 3667	:	20 to 30
Elongation at break	:	100 to 300%
Tensile Strength	:	10 to 20 p.s.i.
Cell Diameters	:	0.25 to 2.00 mm

The thickness of the sheet is preferably in the range from 2 mm to 50 mm.

To provide the sheet of foam material 10 with an abrasive surface, a stencil 11 having a multiplicity of holes 12 in a regular

pattern is arranged against a surface of the sheet and pressure is applied to the stencil to impress it into the sheet as shown in Fig. 1. The stencil 11 is made of a rigid material, for example a metal or a rigid plastics material, and its thickness is typically in the range 0.5 to 2.0 mm though this dimension is not critical. The holes 12 can be of any shape but for convenience will usually be circular and have diameters approximately in the range 2 to 10 mm., or perhaps up to 15 mm. A typical example has circular holes of 8 mm diameter at 12 mm spacing between centres.

Hence the holes have an area approximately in the range 3 to 150 but preferably less than 80 square mm. It will be appreciated that the area of one hole in the stencil is small compared to the area of, for example, a scouring pad for domestic use, which is one of the articles which can be produced directly from the finished sheet of abrasive foam material. The total area of the holes 12 is preferably between 25 and 60% of the total area of the stencil. However if the shape of the holes approximates to a square or rectangle it is possible to increase the total area of the holes to as much as 90% of the total area of the stencil.

Sufficient pressure is applied to the stencil 11 to ensure that foam material protrudes through the holes 12 and projects from the opposite face of the stencil as shown in Fig. 1.

A hardenable liquid resin is applied to the stencil 11 and spread over the stencil by means of a rigid spreader member, for example a metal or hard rubber blade. The resin preferably comprises an epoxy resin and an example of the constituents of a suitable resin is as follows:-

	Parts by Weight
Liquid epoxy resin (DOW DER 321)	40
Amine curing agent (TEPA - tetraethylene pentamine)	4
Water miscible polyamide curing agent (Synolide 960)	6
Abrasive filler (Slate dust) 200 mesh	60
Water	15

DER 321 is a product of the Dow Chemical Company available through Casa Chemicals Ltd. "Synolide 960" is a product of General Mills Corpn. available from Cray Valley Products Ltd. 200 mesh is a sieve size which passes particles of up to 75 μm diameter.

Other resins may be used depending on the intended use of the finished abrasive foam sheet and examples of alternative resins are natural and synthetic rubbers, acrylics, P.V.C., and phenol-formaldehyde resins. Similarly the amount and type of abrasive filler used can be varied and resins containing no abrasive filler can be used.

As the spreader member is drawn across the stencil 11 it comes into contact with the foam material where it protrudes through the holes 12, and smears resin into the material. The stencil 11 is then removed from the sheet of foam material 10 which is then exposed to conditions suitable for hardening the resin associated with the sheet. To harden the example of a resin described above, the sheet should be heated to 125°C for about 5 minutes.

Fig. 2 shows the material produced by this method. The sheet of foam material 10 is provided with an abrasive surface 13 comprising a multiplicity of distinct regions of hardened resin 14 corresponding to the holes 12 in the stencil 11. The resin is incorporated into the sheet of material 10 and does not substantially project above the surface of the sheet. This is due to the compression of the material by the stencil and the working of the resin into protruding areas of foam material as they are engaged by the spreader member. In addition, when the stencil is removed the foam material expands and, since the material is of the "open-cell" type, the liquid resin is drawn into the sheet from cell to cell with the result that, in general, the cells which contain resin are not filled by the resin but have the cell walls coated. The cell structure is thus retained, which is important for the cleaning action of the product. The cell diameters are preferably in the range 0.25 to 2.00 mm.

As can be seen in Fig. 2, the resin is incorporated in the cells of the foam material and in use of a part of the sheet, for example as a scouring pad, the resin is much less likely to get separated from the foam material than if it is applied as a superficial coating. A continuous superficial coating of resin is also prone to splitting, which does not occur if resin is applied in a pattern of distinct small regions. The surface structure of the cells of the foam sheet, within the regions of hardened resin 14, contributes an abrasive effect, as does the discontinuity of the resin-impregnated regions and the presence of any abrasive material in the resin.

Products made using very thin section polyurethane foams (i.e. 2 - 5 mm) are too weak and dimensionally unstable to be durable. Such foams can, however, be easily modified and strengthened by lamination to a lightweight fabric (e.g. cotton or synthetic), either woven or non-woven. These fabrics would have weights of 20 - 100 g/m^2. A further improvement in strength occurs during the coating/printing process, as the liquid resin will completely penetrate the thin foam and adhere to the fabric laminated to the back of the foam.

The resulting product can either be used as an abrasive or cleaning cloth, or further laminated to blocks of polyurethane or other rigid foams and cut up into pads.

Since the structure of the foam and nature of the polymer constituting the foam are retained during the printing and hardening process, the eventual durability of the product is dependent upon the strength of the particular foam used. Therefore, when the cheapest polyurethane foams are used, they are found to be less durable than the better quality foams. However, it has been found that useful products of good durability can be made from the cheapest, lightest density polyurethane foams if a thin film of thermoplastic resin is fused onto the abrasive surface. This film strengthens the foam surface considerably and does not interfere too much with the abrasive properties of the hardened areas on the working surface.

Typical films are: poly(ethylene), poly(ethylene vinyl acetate), plasticised poly(vinyl chloride) and its copolymers, natural rubber - hydrochloride, etc.

Film thicknesses are typically 25 - 50 microns.

The film is fused to the foam surface at 120 - 160°C for 5 - 20 seconds at around 2 kg/cm^2 depending upon the particular film used and thickness of the coated foam.

It will be appreciated that cleaning or scouring pads can be made from a sheet of abrasive foam material according to the invention simply by cutting the sheet into pads of a size suitable for the intended use. Sheets having differing abrasive characteristics may be produced as described above. Cleaning or scouring pads cut from a sheet of abrasive foam may be used to clean, for example, cooking utensils, baths, kitchen sinks, paintwork, and vehicle windscreens. For these purposes they must be used with a liquid, for example water.

CLAIMS:

1. A method of providing an abrasive surface on a sheet of compressible foam polymeric material, comprising the steps of arranging a stencil having a multiplicity of holes against a surface of a sheet of a compressible foam polymeric material, applying pressure to the stencil to impress it into the sheet of foam material, applying a hardenable resin to the surface of the stencil remote from the sheet of foam material, the resin contacting the foam material in the region of the holes in the stencil, removing the stencil and allowing or causing the resin in contact with the foam to harden.

2. A method as claimed in claim 1, wherein the holes in the stencil are circular holes having a total area of between 25% and 60% of the total area of the stencil.

3. A method as claimed in claim 1 or 2, wherein the pressure applied to the stencil is sufficient to cause the foam material to project from the face of the stencil remote from the foam sheet.

4. A method as claimed in any of claims 1 to 3, in which the resin is hardened by heating of the foam sheet after removal of the stencil.

5. A method as claimed in any of the preceding claims, in which the foam sheet is initially laminated with a fabric backing sheet and is of such thickness that the hardenable resin passes through the foam sheet and bonds to the backing sheet.

6. A method as claimed in any of the preceding claims in which after hardening of the resin a thin film of thermoplastic resin is fused to the surface of the sheet carrying the hardened resin regions.

7. A method as claimed in any of the preceding claims, in which the foam material is of the open-cell type.

8. A sheet of compressible foam polymeric material provided with an abrasive surface, the abrasive surface comprising a multiplicity of distinct regions of hardened resin in each of which regions the resin is at least partially incorporated in the sheet to coat the walls of the cells of the foam without filling all the cells with resin.

9. A sheet as claimed in claim 8, in which the hardened resin does not project from the surface of the sheet.

10. A sheet as claimed in claim 8 or 9, in which the regions of hardened resin are circular dots covering an area of between 25% and 60% of the total area of the sheet.

11. A sheet as claimed in any of claims 8 to 10 laminated to a fabric backing sheet and having the hardened resin regions bonded to the backing sheet.

12. A sheet as claimed in any of claims 8 to 11 having a thin film of thermoplastic resin fused to the abrasive surface of the sheet.

FIG. 1

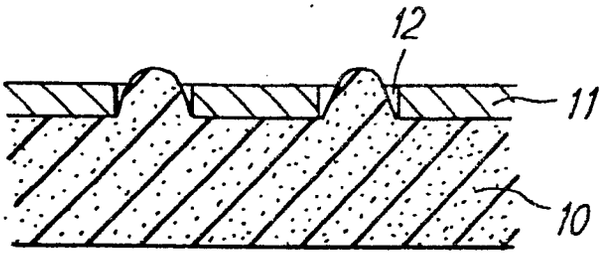
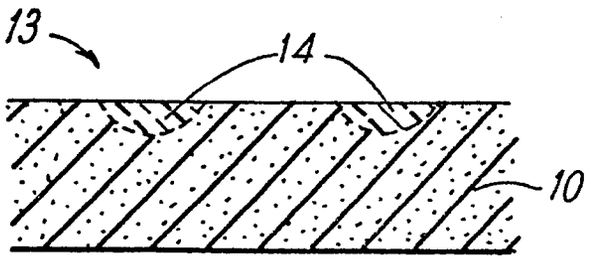


FIG. 2



European Patent Office

EUROPEAN SEARCH REPORT

0010408
Application number
EP 79 30 2194

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 2 596 565 (KAUTENBERG) * Column 4, lines 48-57; figures 1-12 *	8,9, 10,12
	US - A - 3 630 800 (JOHNSON & JOHNSON) * Column 1, lines56-64; figures 1,2 *	8
A	US - A - 2 804 728 (POLITZER)	
A	FR - A - 1 465 778 (COLLO RHEINCOLLODIUM)	
A	US - A - 3 256 075 (KIRK)	
A	US - A - 1 446 998 (VINCENT)	
A	FR - A - 2 299 943 (SCHNURIGER)	
A	US - A - 3 619 843 (RICHTER)	
A	US - A - 1 495 839 (GRIBBEN)	
A	FR - A - 2 315 897 (COLLO)	
A	US - A - 1 896 638 (MacILDOWIE)	

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

B 24 D 15/04

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

B 24 D 15/00
A 47 L 1/00
13/00
17/00
A 47 K 7/00
B 60 S 3/00
B 24 D 11/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16-1-1980	PEETERS S.

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