

PATENT SPECIFICATION

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 3C2G 3C2J 3C2Y 3C3B 3D3J 3D3X



(54) PROCESS FOR TREATMENT OF FILTER MATERIALS FOR USE IN A DUST-RETAINING FACE MASK

(71) We, MITSUBISHI JUKOGYO KABUSHIKI KAISHA, a Japanese body corporate, of 5-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement.

5 The present invention relates to improvements in processes for the treatment of filter materials suitable for use in dust-retaining face masks. 5

A process for the treatment of filter material for use in dust-retaining face masks is already known in which a method of imparting an electrostatic effect to the filter material, such as wool felt, by resin treatment includes the steps of impregnating the filter material 10 with a synthetic resin solution, there-after squeezing out excess solution, and drying the impregnated filter material by heating at about 100°C. In addition, methods of eliminating disadvantages in the known process have been proposed in Japanese Patent Publication No. 39-5987 entitled "Process for Treatment of Filter Materials to be used in a Dust-Proof Mask", and in Japanese Patent Publication No. 45-13317 entitled "Process for Treatment of 15 Air Filter Materials to be Used in a Dust-Proof Mask or the like". The method of the former Publication is characterized in that a solution A is obtained by adding an appropriate amount of hydrochloric acid and ammonium chloride serving as a catalyst to a mixed solution of para-alkylphenols and formalin and heating, a resin B is obtained by adding an appropriate amount of ammonia water serving as a catalyst to a mixed solution of 20 para-tertiarybutylphenol and formalin and heating, a filter material such as wool felt is immersed in the resin liquid obtained by adding the solution A and the resin B in an appropriate amount to benzol and is then dried. The method of the latter Publication is characterized in that a water-soluble resin liquid and an emulsion of vinyl acetate, acrylic acid, acrylic ester, or latex are diluted to an appropriate concentration, a filter material is 25 then given a primary treatment by immersing it in said diluted solution, squeezing out excessive liquid by using, for example, a press or a roll and then drying by the use of heat to obtain primary treated filter material whose gas permeability has not deteriorated. Thereafter a secondary treatment is performed with a resin liquid as used in the method of the former Publication. Either of these two methods results in the provision of a filter 30 material whose electrostatic deposition performance would not be altered substantially even if the immersion of the base material and drying were to be repeated.

According to the present invention there is provided a process for the treatment of filter material for use in a dust-retaining mask, wherein the filter material is impregnated with a solution of a synthetic resin, excess solution is squeezed out of the filter material, the filter 35 material is then subjected to drying treatment to provide a resin film on the filter material and thereafter physical distortion of the filter material is carried out to form cracks in the resin film. By subjecting the filter material to a physical distortion working treatment in accordance with the invention using means described in more detail later, the electrostatic effect can be greatly enhanced as compared with the above-described simple resin 40 impregnating processes, and thereby the dust-collecting efficiency of the filter material can be greatly improved.

More particularly, known filters consisting of wool felt which has been merely subjected to impregnation with synthetic resin and a drying treatment have the disadvantage of poor dust-collecting efficiency for a given thickness of the felt material because the resin adheres 45 to the surface of the fibres of the material simply as a film; in order therefore to attain a

higher dust-collecting efficiency, the thickness of felt and the amount of resin impregnation have to be increased, and consequently the resistance to air permeation and the difficulty of breathing through a mask formed from the material is increased. In contrast, the present invention is based on the discovery that a physical distortion treatment such as by bending, stretching or rumpling by hand produces fine cracks in the resin film on the fibres of the material, resulting in a great improvement in the dust-collecting efficiency. Consequently for a given thickness of filter material the dust-collecting efficiency can be enhanced by the treatment process of the invention in comparison to the known processes, or the material can be made thinner and yet attain the same dust-collecting efficiency enabling the use of filter material having a lower gas permeability without causing undue difficulty in breathing.

Since the process of the present invention results in filter material having a large electrostatic effect, even if a cheap unwoven web consisting of so-called synthetic fibres is employed as the filter material in place of an expensive material such as wool felt, an equivalent filtering effect can be obtained. Therefore, the present invention also has economic advantages.

In carrying the invention into effect, unwoven webs consisting of the so-called synthetic fibres such as acrylic resin, polypropylene or rayon either singly or in combination or webs of felt, foam rubber or urethane foam can be employed as the basic filter materials. With regard to the varieties of synthetic resin to be used for impregnation treatment, almost all the resins such as vinyl acetate resin, acrylic resin, alkyd resin, polystyrol resin or phenol resin are applicable, and the dust-collecting efficiency can be attained in accordance with the type of resin used for the impregnation treatment. As a filter for use in a dust-retaining face mask, vinyl acetate resin, acrylic resin, alkyd resin and polystyrol resin are preferred impregnating resins where safety and hygiene as well as filtering efficiency are of prime consideration.

In contrast to the dust collecting efficiency obtained simply by impregnating a given filter material with a given resin, the dust-collecting efficiency obtained by practicing the physical distortion treatment according to the process of the present invention after the resin impregnation treatment is greatly improved even when the same filter materials and the same resins are used in the two processes.

Examples of treatment processes in accordance with the invention and comparisons of the resulting filter materials with filter materials not produced by processes in accordance with the invention will now be described.

Example 1:

A filter material consisting of felt is immersed in a liquid consisting of 5 parts by weight vinyl acetate resin, 2 parts by weight interfacial activator, 0.5 parts by weight curing accelerator and the remainder water, the vinyl acetate resin being dispersed in an emulsion form. Excess liquid is squeezed out by means of a roll. Preliminary drying is carried out at 50 - 60°C, and the filter material is then heated to dry it at a thermostatically controlled temperature of 100°C.

A part of the filter material treated in this way is then passed three times through an apparatus for performing a physical distortion treatment. This apparatus comprises seven rolls each having a diameter of 10 mm and disposed in a zig-zag manner at an interval of 15 mm (i.e. the distance between the axes of the rolls). The remaining part of the filter material was not subjected to this tanning-equivalent working treatment. The dust-collecting efficiency of the two parts of the filter material were then similarly tested under the following conditions:

1. Kind of dust: welding dust.
2. Dust concentration: 50 ± 10 milligrams/cubic meter
3. Suction speed: 30 litres/minute.
4. Method of measurement: piezo-electric crystal vibration type dust meter

Results of Tests

The part of the filter material not subjected to the physical distortion treatment had a dust-collecting efficiency of 54.5%.

The part subjected to the physical distortion treatment had a dust-collecting efficiency of 99.8%.

Example 2

The procedure of Example 1 was substantially followed. The filter materials used were unwoven webs A, B, C and D, foam rubber and urethane foam. The process was carried out similarly to Example 1, and the results obtained by comparing the dust-collecting efficiencies of parts of the filter material subjected to the physical distortion treatment with parts not subjected to such treatment, proved the advantageous effect of such treatment since every filter material subjected to it had an enhanced dust-collecting efficiency in comparison to material not subjected to it as shown in TABLE - 1.

TABLE - 1

Treatment kinds of Filter Materials	Dust Collecting Efficiency	
	Not Subjected to Physical Distortion Treatment	Subjected to Physical Distortion Treatment
Unwoven Web A	83.2%	99.9%
Unwoven Web B	81.0%	98.4%
Unwoven Web C	54.7%	80.2%
Unwoven Web D	33.9%	45.2%
Foam Rubber	25.4%	29.6%
Urethane Foam	21.5%	27.0%

Example 3

In order to study the variation of the effects of different impregnating resins, the unwoven web C of Example 2 was used as the filter material, and separate parts of it were impregnated with alkyd resin, acrylic resin, acrylic-styrene co-polymer resin as well as the above-referred to vinyl acetate resin. Beyond that the process was practiced as set out in Example 1. Although some differences are to be seen depending upon the kind of resin used, in every case the filter material subjected to the physical distortion treatment according to the process of the present invention presented an enhancement in its dust-collecting efficiency as compared with filter materials not subjected to the treatment as can be seen from Table 2.

TABLE - 2

Treatment kinds of Resins	Dust Collecting Efficiency	
	Not Subjected to Physical Distortion Treatment	Subjected to Physical Distortion Treatment
Vinyl Acetate Resin	54.7%	80.2%
Alkyd Resin	54.7%	63.8%
Acrylic Resin	54.7%	80.1%
Acrylic-Styrene Co-Polymer Resin	54.7%	77.9%

Example 4

As an alternative method of physical distortion treatment to that described in Example 1 in which the filter material is subjected to repeated bending by being passed over a plurality of rolls, the filter material can be passed through a slit-like formation that is narrower than the thickness of the filter material. Thus the physical distortion treatment is effected by stretching the filter material as by pulling one end of the filter material while holding a part of the filter material with appropriate means or pulling the opposite ends of the filter material without holding any part of the filter material, or else the treatment is effected by rumpling the filter material by hand. The dust-collecting efficiency of a treated filter material composed of a fibrous web has been measured and compared in the same manner as in the above-described Examples, and observations of the surface of the filter material by means of a microscope have been made. According to the microscopic observations, the filter material subjected to the physical distortion treatment had fine cracks in the resin film adhered onto the fibres and the fibres themselves were fluffy. Since the dust-collecting efficiency is related to the change in condition of the filter material brought about by the physical distortion treatment, it is considered that in comparison to an untreated filter material, the absorptive area is increased by the cracks as well as by the fluffy condition of the fibres and thereby the electrostatic effect is also remarkably enhanced.

As described in detail above, the process according to the present invention is characterized in that after an appropriate filter material has been subjected to resin impregnation and drying treatment through known methods, the filter material is subsequently subjected to a physical distortion treatment as by mechanically bending or stretching, by rumpling by hand or by similar physical methods, and since the dust-collecting efficiency can be greatly improved in comparison to the prior art treatment in which only resin impregnation and drying are involved, the invention is industrially very

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useful in that an excellent dust-collecting efficiency can be attained even if a cheap filter material such as an unwoven web or a filter material having a lower gas permeability is employed.

WHAT WE CLAIM IS:

- 5 1. A process for the treatment of filter material for use in a dust-retaining mask, wherein the filter material is impregnated with a solution of a synthetic resin, excess solution is squeezed out of the filter material, the filter material is then subjected to drying treatment to provide a resin film on the filter material and thereafter physical distortion of the filter material is carried out to form cracks in the resin film. 5
- 10 2. A process according to claim 1, wherein the filter material is composed of fibres and the physical distortion also renders the fibres fluffy. 10
3. A process according to claim 1 or 2, wherein said physical distortion is effected by bending, stretching or rumpling of said filter material.
- 15 4. A process according to claim 2, wherein the filter material is in the form of an unwoven web of fibres. 15
5. A process according to claim 1 and substantially as hereinbefore described with reference to Examples 1 to 4.

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