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(54) **Method for treatment of impregnated clothes and a machine for performing said method.**

(57) Method for treatment in an ordinary drum washing machine of impregnated garments having water and oil resistant properties, preferably firemen's clothing. In accordance with the method, in dependence on the degree of soiling the garments are treated in a prewash cycle with subsequent drainage of wash liquid and in a main wash cycle, or in a main wash cycle only, in a water-based wash bath containing a soapless detergent. The garments are then rinsed in a number of rinsing cycles with intermediate drainage of the rinsing water and eventually a short spin-drying cycle. Then follows a final spin-drying cycle and subsequent heat drying, whereafter the garments are treated in an impregnation bath comprising a water solution of a cationic fluorocarbon resin. Finally, the garments are again dried.

A machine for treatment of impregnated garments according to the method comprises a tub (11) contained in a housing (10), said tub (11) having a drain (17) and a first drainage valve (18), a drum (12) for supporting the garments rotatably disposed in said tub (11) and driven by an electric motor (13), water supply means (15,16), heating means (26) for heating the wash liquid, and a program control device (14) for control of the treatment cycles in the machine, said program control device permitting the common cycles of prewash, main wash, rinse and spin-drying to be performed. Further, the machine has a design so as to permit a reimpregnation cycle to be performed for a predetermined period of time and in the presence of an impregnation liquid of the kind referred to. The machine comprises a tank (22) for the impregnation liquid, a pump (24) for circulating said liquid in a closed loop from the tank (22), via the drum (12) and the drain (17) of the tub (11) and a separate valve (21) back to the tank.

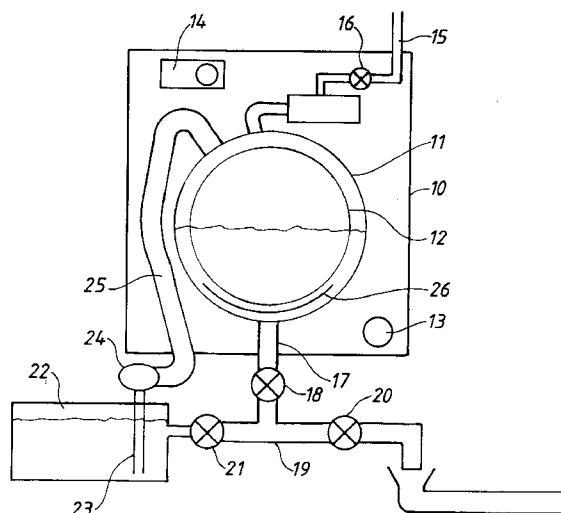


Fig.1

The present invention relates to a method for treatment of impregnated clothes, preferably firemen's clothing, in an ordinary drum type laundry washing machine, said clothes having water and oil resistant properties.

Primarily, the invention is applicable to firemen's clothing made of a material named NOMEX and comprising three layers, namely an outer cloth, a wadding layer and an inner lining. By itself, the material is flameproof. The glass transition temperature is in the range of 250-400°C whereas the melting point is above 400°C. As a result of these properties, washing will not cause any problems of shrinkage or wrinkling. However, there are problems related to colour fastness and, moreover, the material is apt to aging when exposed to UV light.

Fire cloths are provided with reflective strips due to which said cloths must not be washed at a temperature exceeding 60°C. After repeated washings the oil resistant properties, in particular, deteriorate which results in a need for reimpregnation of the cloths after wash. In the case of lightly soiled garments a wash in a wash solution comprising a soapless detergent may cause the oil resistant properties to recover to a certain degree. In the case of normally and heavily soiled garments, however, no such improvement is obtained.

An object of the invention is to provide a method for treatment of impregnated cloths, especially firemen's clothing, having water and oil resistant properties, said treatment being such that the cloths be cleaned and at the same time the oil resistant properties recover which have got lost by use and by the wash of said cloths. Another object of the invention is to provide a machine for washing and reimpregnation of the garments in accordance with said method.

The objects indicated have been achieved by a method according to claims 1-7 and in a machine according to claims 8-9.

The invention will now be described more in detail in connection with a presentation of a number of tests including washing and subsequent impregnation and with reference to the accompanying drawings, in which:

Fig. 1 schematically shows a washing machine in accordance with the invention; and

Fig. 2 shows a program chart for different wash programs as well as a reimpregnation program for treatment of garments in the machine shown in fig. 1.

Firemen's cloths made of the material NOMEX, discussed above, have been washed and reimpregnated in two different tests which will be presented below. In the first one of said tests new garments were used which were washed and tumble dried a number of times. After each complete cycle of washing and drying the degree of oil fastness was measured.

In the second test three sets of firemen's clothing were soiled by firemen on duty and the garments were then to be cleaned by washing. The oil fastness was measured after the cloths had been soiled, after washing and drying and after reimpregnation.

In the wash tests a soapless detergent, Bio Luvil Special, was used at a dosage of 10 g/kg. The load degree has been 1/20 and a set of firemen's clothing (jacket and trousers) has a weight of about 3 kg. The machine used was of the type Wascator WE 65 MP having a drum volume of 60 litres and, accordingly, one set is a suitable load per wash. Three different wash programs will be described and a reimpregnation program, as well. The drying of the garments subsequent to washing has been carried out separately in a tumble drier of the type Wascator TT 210. A prerequisite has been for the drying temperature to be at least 85°C but not to exceed 120°C.

Test No. 1

A set of firemen's clothing was washed three times according to program No. 2 (normally soiled 60°C), see the program chart of Fig. 2. According to the dosage instruction 30 g of Bio Luvil Special was dosed in each wash. As appears from the program chart, the program comprises a main wash for 12 minutes followed by three rinsing cycles of 2 minutes each, a final rinse for 3 minutes and spin-drying for 6 minutes. The overall program time is 46 minutes.

Prior to wash the oil fastness had a value of 6 (as measured in accordance with a predetermined method named "AATCC Test Method 118-1983") while after three washes the value had lowered to 2-3. The garments contained a rest humidity of 20% after spindrying. Subsequent to each wash a tumble drying cycle took place in a machine of the type indicated at 85°C for ca. 20 minutes. Then, the garments were overdried for another 30 minutes whereafter the temperature of the garments was measured to be 95°C. Finally, the fire men's clothes were reimpregnated in an impregnation liquid of the type Querophob BSN at a dosage of 10 g/l. This liquid can be described, more specifically, as a liquid solution of a cationic fluorocarbon resin. Accordingly, in the washing machine referred to the dose amounted to 300 g in a wash bath of 30 l. The reimpregnation program (program No. 5 in the program chart) was run and as appears from the chart said program is similar to a wash at 40°C without prewash and rinses. The impregnation lasts for 35 minutes and ends by a spin-drying cycle of 6 minutes. Finally, the garments were tumble dried for 50 minutes in a tumble drier of the type indicated.

The oil fastness was measured to be 5-6 after reimpregnation.

The oil fastness for clean garments are shown in the table below.

Before wash	6
After one wash	4-5
After two washes	2-3
After three washes	2-3
Another 10 minutes of drying	2-3
After two extra rinses	2-3
After reimpregnation	5-6

Test No. 2

In a second test three sets of firemen's clothing were included which had been soiled by firemen on duty. The three sets were soiled to various extent such that one set was lightly soiled, the second one was fairly soiled whereas the third set was heavily soiled. The oil fastness was measured prior to wash and it turned out that the oil fastness was already low before the garment had been washed. The values were 2-3 for the lightly soiled garments and 1-2 for the remaining ones.

The lightly soiled garments were washed according to program No. 1, see the program chart of Fig. 2. The dosage of detergent amounted to 50 g of Bio Luvil Special and the program was running for 42 minutes. As appears more specifically from the chart, the program comprised a main wash for 12 minutes, three rinses of 2 minutes each, a final rinse of 3 minutes and a final spindrying cycle of 6 minutes.

The garments looked clean after being washed but reflective strips disposed on the garments had remaining black stains. The lining was lightly gray (coloured).

After the wash the garments were dried in a tumble drier of the type Wascator TT 210 for 50 minutes. Thereafter, the oil fastness was measured and the value was found to be 4. After that, the garments were reimpregnated according to program No. 5, see the program chart, in the washing machine indicated. Impregnation took place at 40°C and with the bath containing 250 g of BSN. After spin-drying the garments were dried in the tumble drier mentioned for 50 minutes. Then, the oil fastness was measured to be 5-6.

The fairly soiled garments were washed according to program No. 2, see the program chart of Fig. 2. The dosage was 50 g of Bio Luvil Special and the program lasted for 46 minutes. As appears from said program chart, more specifically the program is the same as program No. 1, already described, with the difference that the temperature in the wash cycle be increase to 60°C.

After wash the garments were felt to be clean but remaining stains were present on the reflective parts. The lining was gray (coloured).

After tumble drying for 50 minutes in the way described the oil fastness was measured to be 1-2 on the leg of the trousers whereas the value 2-3 was obtained higher up on the trousers where the jacket could provide protection to some extent. After reimpregnation according to program No. 5, see the program chart, the oil fastness was measured to be 5-6.

The heavily soiled garments were washed in accordance with program No. 3, see the program chart. The dosage was 50 g of Bio Luvil Special in the prewash and the same dose was used in the main wash. The program lasted for 54 minutes. As appears from the program chart the program comprises a prewash for 6 minutes and a main wash for 15 minutes. As to the rest, the program proceeds through rinses and a final spin-drying cycle as in programs Nos. 1 and 2.

After wash the garments had remaining stains of fat, oil and soot. After drying in a tumble drier in the way described the oil fastness was measured to be 1 unit, corresponding to the value prior to wash. In an attempt to additionally clean the garments one of them was soaked in a microemulsion available on the market under the brand Berol (a micro-emulsion contains in various proportions perchloroethylen, tensides and water) and then the garments were washed in accordance with program No. 2 without any further addition of detergent. Another garment was washed according to program No. 2 in a bath having a dosage in it of 50 g of HAMIX. Both garments became considerably cleaner and after drying the oil fastness was measured to be 1-2.

The last-mentioned garments were then reimpregnated in the washing machine according to program No. 5 of the program chart in a bath containing 300 g of BSN. After drying the oil fastness was measured to be 4-5 with respect to the garment washed in the microemulsion. The corresponding value for the garment washed in HAMEX amounted to 4.

In the following table a tabulation is given as to the oil fastness of garments variously soiled.

		<u>Lightly soiled</u>	<u>Normally soiled</u>	<u>Heavily soiled</u>
5	Prior to wash	2-3	1-2	1-2
	After wash in Bio Luvil Special and tumble drying	4	1-2	1-2
10	After wash in microemulsion			1-2
	After wash in HAMEX			1-2
15	After reimpregnation	5-6	5-6	4-5 4

From the tests shown the conclusion could be made that firemen's clothing in dirty condition has a low oil fastness. After wash using a soapless detergent the oil fastness may increase for lightly soiled garments whereas with respect to normally soiled and heavily soiled garments no improvement could be obtained.

Microemulsion and HAMIX have shown to be efficient on the type of soil present on firemen's clothing.

In order for the oil fastness to be restored it is necessary to reimpregnate the garments after every wash. Preferably, the impregnation bath can be reused several times which is suitable for cost and environmental reasons.

After impregnation the oil fastness will be the same as for new garments. Somewhat lower values were obtained, however, for garments washed in microemulsion and in HAMIX, respectively. It has not been possible to confirm whether this is due to the garments being extra heavily soiled or whether the detergents only caused the somewhat lower values of oil fastness.

In principal, the washing of firemen's clothing as described can take place in an ordinary drum washing machine. With respect to the reimpregnation, however, the washing machine has to be completed to some extent. In Fig. 1 a washing machine is schematically shown which is suitable both for washing and reimpregnation. The machine is of the common type comprising a tub 11 enclosed in a cabinet 10. A drum 12 for supporting the garments to be treated is rotatably disposed in the tub. The drum is driven by an electric motor 13 of any suitable kind and the machine is functionally controlled by a program control device 14, usually named programmer.

The machine has a water inlet 15 and water is supplied to the machine via an ordinary solenoid valve 16. A heating element 26, also of common type, is provided in the tub for heating of treatment liquid to a desired temperature. The machine is of the type having its drain 17 positioned at a low point and provided with a first drainage valve 18 to which a branch 19 is connected. Via a second drainage valve 20 said branch is connected to an exterior drainage. Moreover, via a further separate valve 21 the branch 19 is connected to a tank 22 containing impregnating liquid. In the tank there is provided a suction pipe 23 leading to a circulation pump 24 which, via a conduit 25, pumps liquid from the tank 22 in a closed loop through the drum 12 with the garments, the tub 11, the drain 17, the first drainage valve 18, the separate valve 21 and back to the tank.

During the performing of a wash program in the machine the components connected to the tank 22 are inoperative and liquid is drained off from the machine via the two drainage valves 18, 20. However, during the performing of an impregnation program in the machine, program No. 5 according to the program chart, the second drainage valve 20 is closed whereas the first drainage valve 18 and the separate valve 21 are both open. At the same time the pump 24 is activated pumping the impregnation liquid in the closed loop mentioned. When the impregnation cycle has been completed the pump 24 is inactivated. Then, the final spin-drying cycle takes place with the machine set as a washing machine, however, having said second drainage valve 20 closed while the separate valve 21 is still open. Accordingly, the extracted impregnation liquid flows back into the tank 22 to be reused in further impregnation cycles. When the spin-drying cycle has been completed the separate valve 21 is closed while the second drainage valve 20 is opened. Then, the machine is ready for another washing or impregnation process.

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Claims

1. Method for treatment in an ordinary drum washing machine of impregnated garments having water and

- oil resistant properties, preferably firemen's clothing, **characterized** in that in dependence on the degree of soiliness the garments are treated in a prewash cycle with subsequent drainage of wash liquid and in a main wash cycle, or in a main wash cycle only, that during the prewash cycle and the main wash cycle, respectively, the garments are treated in a water-based wash bath containing a soapless detergent, that the garments are then treated in a number of rinsing cycles with intermediate drainage of the rinsing water and eventually a short spin-drying cycle, and that the garments are then treated by a final spin-drying cycle and subsequent heat drying, whereafter the garments are exposed to a bath of impregnation liquid comprising a water solution of a cationic fluoric carbon resin, and that, finally, the garments are again dried.
2. Method according to claim 1, **characterized** in that for lightly soiled laundry only a main wash is carried out which lasts for 12 minutes at a temperature of 50°C.
 3. Method according to claim 1, **characterized** in that for normally soiled laundry only a main wash is carried out which lasts for 12 minutes at a temperature of 60°C.
 4. Method according to claim 1, **characterized** in that for heavily soiled laundry prewash is carried out for 6 minutes at a temperature of 40°C followed by a main wash for 15 minutes at a temperature of 60°C.
 5. Method according to claim 1, **characterized** in that drying takes place for ca. 20 minutes at 85°C followed by an overdrying for ca. 30 minutes at the same temperature causing the garments to obtain a temperature of ca. 95°C.
 6. Method according to claim 1, **characterized** in that the reimpregnation cycle is performed in a washing machine in the presence of an impregnation liquid which is circulated in a closed loop and introduced into the drum by a pump, wherein said cycle lasts for 35 minutes at a temperature of 40°C, whereafter drainage and spin-drying are performed and, finally, a separate drying for about 50 minutes at a temperature of 85°C.
 7. Machine for the treatment of impregnated garments having water and oil resistant properties, preferably firemen's clothing, comprising a tub (11) contained in a housing (10), said tub (11) having a drain (17) and a first drainage valve (18), a drum (12) for supporting the garments rotatably disposed in said tub and driven by an electric motor (13), water supply means (15,16), heating means (26) for heating the wash liquid, and a program control device (14) for control of the treatment cycles in the machine, said program control device permitting the common cycles of prewash, main wash, rinse and spin-drying to be performed, **characterized** in that the program control device (14) is further arranged to permit an impregnation cycle to be performed for a predetermined period of time and in the presence of an impregnation liquid comprising a water solution containing a cationic fluoric resin, said machine comprising a tank (22) for the impregnation liquid and a pump (24) for circulating said liquid in a closed loop from the tank (22), via the drum (12) and the drain (17) of the tub (11) and a separate valve (21) and back to the tank.
 8. Machine according to claim 7, **characterized** in that the program control device (14) controls the impregnation cycle to be carried out for 35 minutes at a temperature of 40°C, whereafter the pump (24) is inactivated while the separate valve (21) remains open during a subsequent spin-drying cycle.
 9. Machine according to claim 7, **characterized** in that the drain (17) from the tub (11) comprises a branch (19), a first arm of which being connected to an exterior drainage via a second drainage valve (20), whereas a second arm is connected to the tank (22) via the separate valve (21).

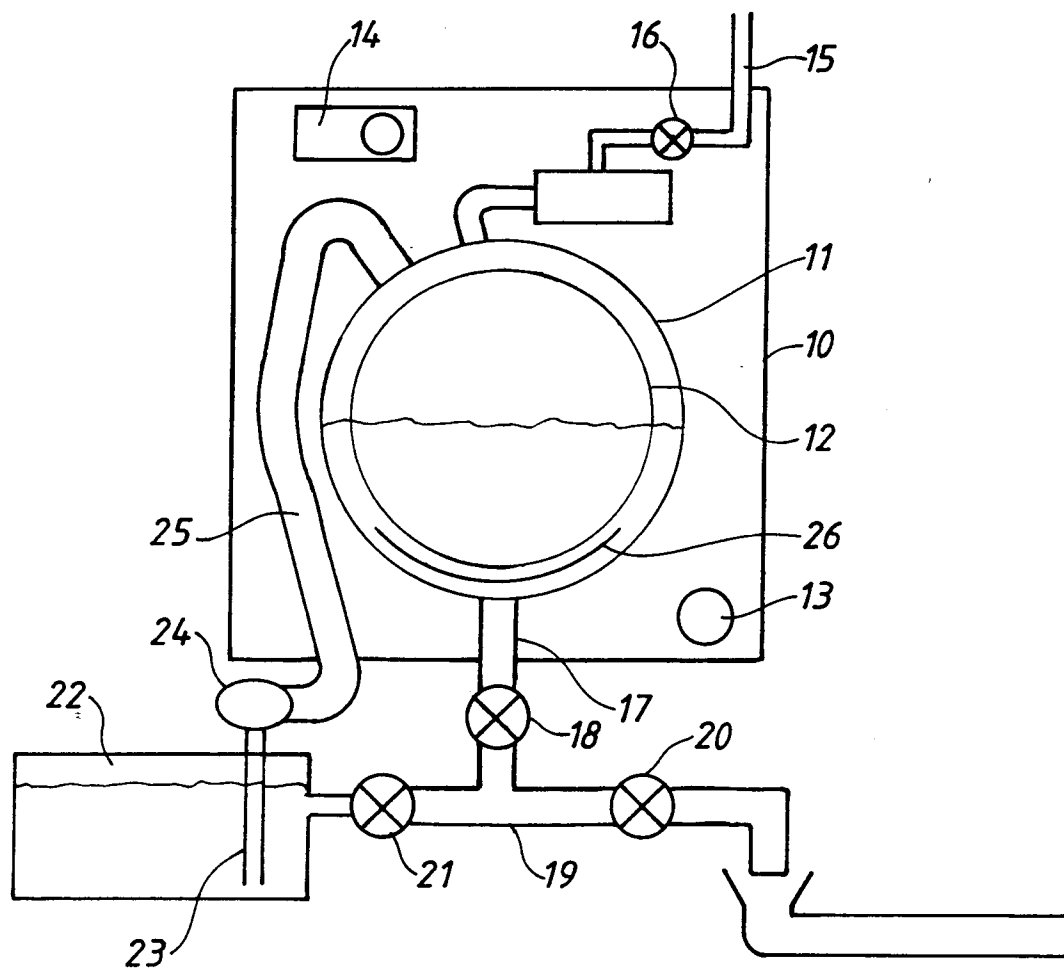


Fig.1

[illegible]

-=NO ACTION
G=GENTLE ACTION
N=NORMAL ACTION
D=DISTRIBUTION
E=EXTRACTION

C = COLD WATER
W = WARM WATER
H = HOT WATER

LL = LOW LEVEL
ML = MEDIUM LEVEL
HL = HIGH LEVEL

Fig. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 85 0292

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A-1 171 952 (COLGATE-PALMOLIVE) * claims 1-4 *	1	D06F35/00
A	EP-A-0 079 234 (PROCTER & GAMBLE) * abstract; figure 1 *	7	
A	US-A-4 595 518 (DU PONT DE NEMOURS)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D06F D06M D06N
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 MARCH 1993	Examiner PETIT J-P
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