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(57) Abstract

A textile material, incorporates at least three components, of which a first and second are flammable and a third is uninflammable, and in which said flammable components together provide between 50% and 75% of the total, with one of the flammable components providing at least 15% of the total, the components being so inter-related that the textile material exhibits delayed flammability characteristics. By additionally controlling the inter-relationships between the components it can be arranged that textile material formed therefrom can, in addition to the delayed flammability, have predetermined moisture characteristics, an abrasion resistance that is the same as or better than that of cotton, and be colour printable by means of printing systems suitable for the printing of 100% cotton material.

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IMPROVEMENTS IN TEXTILE MATERIALS

This invention relates to textile materials and more particularly to textile materials which are flame protective and are particularly suitable for heavy duty usage in fire hazardous environments.

In order to further the concepts of the present invention a completely different approach will be proposed in relation to the question of a textile material's performance in relation to flame protection in that it will be accepted that there may well be circumstances in which one or more of the properties of flame protective textiles could, for example, in the application thereof to clothing for the well being, safety or survival of the wearer, be regarded as being as important.

Such circumstances can arise, for example, with military use in which the dangers for infantry personnel are not only the hazards of heat and flames, but can be such that user safety and survival depends a great deal upon fitness and ability to adjust individually to the dangerous circumstances likely to be involved.

For such reasons, the clothing must keep the wearer as comfortable as possible whereby other factors such as moisture absorbancy and ventilation of the clothing become important, as the clothing must support the thermo-regulation of the body during wide variations of work load and environments encountered.

Thus, for example, clothing must protect the body against inclimate conditions such as rain and cold. In certain applications, for example, military use clothing must also be able to protect the wearer against discovery

or recognition so that it must be possible to pattern the material, for instance, by printing the clothing for camouflage purposes.

In practice, it should be understood that clothing must have a good serviceability i.e., it must not wear out too quickly which means amongst other things that the fabric forming the clothing must have good abrasion resistance.

Furthermore, textile materials according to the invention need not be excessively expensive as compared with more conventionally used flame protective textile materials.

With regard to above mentioned other conventional clothing textile factors the flammability factor although one of the most important is often not considered to be one with the highest priority.

In this specification the term flammability is defined in terms of the ignition tests specified by British Standard Specification No BS 5438:- Methods of tests for flammability of vertically oriented textile fabrics and fabric assemblies subjected to a small igniting flame; and British Standard Specification No BS 3119:- Method of test for flameproof materials. The proposals of BS No 5438 involve flaming of the surface of the material being tested whilst the proposals of BS No 3119 involve flaming at the edge of the matertial being tested.

In this connection, ignition is defined as the flaming of the cloth for a period of one second or more after extinquishing of the igniting flame. The time of flaming on the surface needed to ignite the fabric for

several materials is as follows:-

100% cotton ignition time less than 1.5 seconds.

100% polyamide ignition time 3.5 seconds.

100% polyester ignition time less than 1.5 seconds.

100% wool ignition time 5.7 seconds.

In accordance with the BS 5438 the above materials are regarded as flammable since they will ignite if flamed for 10 seconds. If a material does not ignite after flaming on the surface for 10 seconds, the material, in accordance with BS 5438 can be called uninflammable.

It has been found that if such fabrics which can be called uninflammable in accordance with BS No 5438 are tested in accordance with the proposals of the BS 3119 e.g., flaming at the edge of the fabric (where there is a greater quantity of oxygen) ignition can occur so that such fabrics can not in accordance with the teaching of the present Application be regarded as being completely uninflammable.

Since, in practice, the factors important for producing uninflammable fabrics often conflict with desirable conventional textile properties or aspects such as moisture absorbancy, abrasion resistance, printability etc., it is proposed in the present Application to combine with such conventional textile properties or aspects a further property which is to be associated with the flammability of a textile material and which enables a measure of selective control over said conflict. This further property is called "delayed flammability"

"Delayed flammability" materials can be considered as those which have an ignition time which is 10 seconds or more if flamed on the surface in accordance with BS 5438 but do ignite if flamed for 12 seconds on the border or edge in accordance with BS 3119.

Broadly, according to the present invention there is provided a textile material, incorporating at least three components, in which a first and a second are flammable and a third is uninflammable, and in which said flammable components together provide between 50% and 75% of the total, with one of the flammable components providing at least 15% of the total, the components being so inter-related that the textile material exhibits delayed flammability characteristics.

Preferably, a particular blend of the textile material is formed from an intimate blend of 30% cotton fibres, 40% flame retardent viscose rayon fibres of nearly cotton fineness (1.4-2.2 dtex/38-40mm) or modacrylic fibres of nearly cotton fineness or flame retardent polyester fibres of nearly cotton fineness (1.4-2.2 dtex/38-40mm) and 30% polyamide fibres of nearly cotton fineness (1.4-2.2 dtex/38-40mm).

It has been surprisingly and unexpectedly found that the intimate blending of a third flammable fibre into an intimate blend of two fibres of which one is a flammable fibre and the other is an uninflammable fibre and which blend has no "delayed flammablility" results in an overall blend with a "delayed flammability".

In practice, in relation to the flammability of clothing materials a "delayed flammability" gives the wearer a considerable time period in order to be able to escape from a fire hazardous environment as compared with

that available with conventional flammable clothing materials not exhibiting the delayed flammability.

To demonstrate further the significance of "delayed flammability" a number of fabrics comprising various fibre blends were formed into sample fabrics. For the purposes of the present Application each sample fabric comprised a plain weave in which the warp and weft threads were each equal to 21 per centimetre when in the loom state. In addition, the yarn diameters cf.0,256 mm were maintained constant to maintain the same degree of cover for each fabric. It is convenient to note that with this mode of forming the samples the sample specific weight varies according to the blend.

All of the following samples A to K were examined and tested in accordance with the above mentioned British Standards Nos BS 5438 and BS 3119 and, in addition, the moisture and abrasion characteristics were investigated. In the following tables the Taber Abrasion data represents the mean result of testing in warp and weft directions according to ASTM D 1175.33 until 42 with wheels cs-17, and load adjustment one Kg after 250 revolutions. The material Moisture Regain was measured at 65% Relative Humidity and at 20 Degrees Celcius. The Maximum Evaporation rate can be defined as follows:- the Maximum evaporation gives an indication of the moisture behaviour of a sample in relation to that of cotton. Furthermore, the Samples G,H.J and K were additionally tested under BS 5438 conditions but to an increased time of 15 seconds. The Flammability performances remained unchanged.

SAMPLE A

Material CO (100% Combed Cotton)	
Yarn Count(Tex)	53.6
B.S 3119 Result	Flammable
B.S.5438 Result	Flammable
Flammability Performance	Flammable
Taber Abrasion	29%
Break-open	-
Moisture Regain	6.1%
Maximum Evaporation Rate	3.8g/h
Remarks	

SAMPLE B

Material FR (Flame Resistant Viscose Rayon 1.7 dtex/38mm produced by Lenzing A.G. Austria)

Yarn Count(Tex)	52.7
B.S 3119 Result	Inflammable
B.S.5438 Result	Inflammable
Flammability Performance	Inflammable
Taber Abrasion	63%
Break-open	Yes
Moisture Regain	8.4%
Maximum Evaporation Rate	4.3g/h
Remarks	

SAMPLE C

Material MOD (Modacrylic 1.7 dtex/38mm, produced by SNIA-Viscose, Italy)

Yarn Count (Tex)	39.9
B.S 3119 Result	Inflammable
B.S.5438 Result	Inflammable
Flammability Performance	Inflammable
Taber Abrasion	69%
Break-open	Yes
Moisture Regain	1.6%
Maximum Evaporation Rate	4.9g/h
Remarks	After-glow

SAMPLE D

Material PA (Polyamide-Nylon 6.6, 1.7 dtex/38mm, produced by Rhodia A.G. West Germany)

Yarn Count(Tex)	39.9
B.S 3119 Result	Flammable
B.S.5438 Result	Flammable
Flammability Performance	Flammable
Taber Abrasion	22%
Break-open	
Moisture Regain	3.7%
Maximum Evaporation Rate	4.5g/h
Remarks	Drips

SAMPLE E

Material CO/FR 50/50%	
Yarn Count(Tex)	53.2
B.S 3119 Result	Flammable
B.S.5438 Result	Flammable
Flammability Performance	Flammable
Taber Abrasion	
Break-open	
Moisture Regain	
Maximum Evaporation Rate	
Remarks	

SAMPLE F

Material CO/MOD 50/50%	
Yarn Count(Tex)	46.8
B.S 3119 Result	Inflammable
B.S.5438 Result	Flammable
Flammability Performance	Flammable
Taber Abrasion	
Break-open -	
Moisture Regain	
Maximum Evaporation Rate	
Remarks	

SAMPLE G

Material CO/FR/PA	33.3/33.3/33.3%
Yarn Count(Tex)	48.4
B.S 3119 Result	Flammable
B.S.5438 Result	Inflammable
Flammability Performance	Delayed Flammability
Taber Abrasion	21%
Break-open	No
Moisture Regain	
Maximum Evaporation Rate	
Remarks	

SAMPLE H

Material CO/MOD/PA	33.3/33.3/33.3%
Yarn Count(Tex)	44.4
B.S 3119 Result	Flammable
B.S.5438 Result	Inflammable
Flammability Performance	Delayed Flammability
Taber Abrasion	19%
Break-open	No
Moisture Regain	4.1%
Maximum Evaporation Rate	4.5g/h
Remarks	

SAMPLE J

Material CO/FR/PA 30/40/30%	
Yarn Count (Tex)	49.2
B.S 3119 Result	Flammable
B.S.5438 Result	Inflammable
Flammability Performance	Delayed Flammability
Taber Abrasion	20%
Break-open	No
Moisture Regain	6.4%
Maximum Evaporation Rate	3.5g/h
Remarks	

SAMPLE K

Material CO/FR/MOD/PA30/20/20/30%	
Yarn Count(Tex)	49.2
B.S 3119 Result	Flammable
B.S.5438 Result	Flammable
Flammability Performance	Delayed Flammability
Taber Abrasion	10%
Break-open	No
Moisture Regain	4.9%
Maximum Evaporation Rate	4.1g/h
Remarks	

The significance of the data given in relation to samples A to K can be briefly explained as follows. It will be seen that the combination of a flammable component and an inflammable component results in a flammable material whereas if one adds to any one of these two components a third flammable component the very surprising result is a material with delayed flammability. For instance, if polyamide fibres, which have an ignition time of 3.5 seconds, are added to a blend of 50% cotton and 50% flame retardent viscose rayon fibres, such that the blend consists of 33.3% cotton and 33.3% flame retardant viscose rayon fibres and 33.3% polyamide, the ignition time of the resulting blend increases unexpectedly to more than 15 seconds. In the case of Sample J i.e., a fibre blend composition including 30% cotton, 30% polyamide fibres and 40% flame retardent viscose rayon fibres surprisingly resulted in fabric with an ignition time of more than 15 seconds without break-open or after-glow.

Surprisingly it has been found that if cotton fibres which have an ignition time smaller than 1.5 seconds are added to a blend such that the blend consists of 33.3% cotton, 33.3% polyamide fibres and 33.3% modacrylic fibres the ignition time of the resulting blend increases unexpectedly to more than 15 seconds without break-open or after glow.

With known flammable textile materials it has historically been necessary to atempt to attain as high as possible inflammability property. A direct consequence of this, in practical terms has been that users of such materials have had little or no control over other practically important factors such as the

moisture absorption, abrasion resistance etc. However, with the production of materials in accordance with the invention having "delayed flammability" it is possible to relax or reduce without lowering the effective protection afforded, the absolute level of inflammability and to formulate fabrics having more user acceptable properties of moisture control, abrasion resistance etc., retaining the desired "delayed flammability".

It is also known in textile technology that combining different fibres to obtain a combination of properties is not always a matter of simple arithmetic. This is because, apart from the "weakest link factor" unexpected results can occur.

It is known that the different textile fibres (natural, artificial, and synthetic) have different moisture absorbancies.

The moisture content of textiles comprises various components such a "on-fibre"; "in-fibre"; and "in between fibre" moisture. The "in-fibre" moisture is the percentage of moisture which is absorbed by the fibre itself, and will be higher if the fabric is really wetted.

However, a fabric made of yarns spun from these fibres will absorb much more moisture. If wetted, the moisture will penetrate "between" the fibres, this being known as capillary bond or "between fibre moisture". This amount of moisture is dependedent upon the fibre material itself and also upon the fineness of the fibre , i.e., the measure of the capillary holes between the fibres.

The moisture absorption of a fabric is, in

practice, dependent upon all of the types of absorption i.e., "in-fibre" "on-fibre" and "between-fibre" moisture".

The amount of "in-fibre moisture" absorpbancy of 100% cotton (in climates with mostly a low relative humidity) is known as being comfortable during changing heavy workloads.

For climates with mostly a low relative humidity the material defined by Sample J is particularly suitable since it exhibits substantially the same absorption characteristics as 100% cotton. Thus the material defined by sample J, which is an intimate blend consisting of 30% cotton fibres, 40% fire retardent viscose rayon fibres of nearly cotton fineness and 30% polyamide fibres of nearly cotton fineness be considered to have been formulated with the object of providing a material with not only a desirable level of delayed flammability but also with an acceptable comfort performance as regards moisture content.

In climates with a high relative humidity, mostly with relatively high temperatures, the evaporation of the moisture in fabrics occurs slowly in general whereby, in practice, there is a need to find means of increasing the rate of evaporation.

In the case of climates with mostly a high relative humidity it is possible to modify the blend of Sample H so that it retains the desirable characteristic of "delayed flammability" whilst providing an acceptable level of moisture content comfort. The modified Sample H is an intimate blend as follows and consists of 30%

cotton fibres, 40% modacrylic fibres of nearly cotton fineness (1.7-2.2 dtex/38-40 mm) and 30% polyamide fibres of nearly cotton fineness (1.7-2.2 dtex/38-40mm).

With regard to the control of comfort via the above mentioned aspects of thermo-control by moisture evaporation properties it is evident that the materials used in clothing for people operating alternately in different climatical environments like stand-by emergency military forces, or in climates with moderate humidity, a combination of the above mentioned solutions has to be found.

Preferably, in the case of clothing used for climates with a moderate humidity the intimate blend comprises 30% cotton fibres, 20% fire retardent viscose rayon fibres of nearly cotton fineness (1.4-2.2 dtex/38-40 mm), 20% modacrylic fibres of nearly cotton fineness (1.4-2.2 dtex/38-40mm) and 30% polyamide fibres of nearly cotton fineness (1.4-2.2 dtex/38-40mm).

Reference will now be made to the accompanying graphs which illustate various relationships relevant to the moisture contents of textile materials based upon the concepts of the invention in which:-

Figure 1 is a graph illustrating the evaporation rates of materials utilised in the textile materials of the invention; and

Figure 2 is a graph illustrating the evaporation rates of textile material blends in accordance with the above mentioned Samples H, J and K.

The data for plotting the graphs of Figures 1 and 2 was established as follows:- An infra-red form of heater

was arranged to be able to direct infra-red energy towards the load receiving pan of a weight measuring apparatus capable of measuring relatively small values of weight change.

Samples of the materials to be examined in respect of moisture evaporation were produced in the form of circular discs having an area of 5 square centimetres. All of the samples were bone dried and then conditioned for twenty four hours at 65% Relative Humidity and 20 degrees Celcius. After which each sample was tested. Each sample was during the testing thereof placed upon the scale pan and 0.1 grams of water was applied thereto in the form of fifteen drops evenly spread over the sample.

The initial weight of the sample plus water was recorded and the infra-red heater was switched On and the heater was allowed to reach a temperature of 75 degrees Celcius at which temperature the heater was switched Off. The evaporation of the water from the sample was monitored by noting the weight of the sample at regular time intervals and the data obtained used to establish the evaporation rate. The evaporation rates determined were plotted against time in minutes to establish the graphs of Figures 1 and 2.

A comparison the graphs of Figures 1 and 2 clearly illustrates that whilst some of the components of the Samples have evaporation rates which differ considerably from that of cotton the moisture evaporation rates of the materials according to the Samples H, J and K of the invention. Sample J of the invention equates to that of 100% cotton, and the samples H and K exhibit a predetermined somewhat different moisture evaporation rate from that of cotton.

It can be seen that the maximum evaporation rate for each sample (as is also mentioned in the samples) gives an indication of the moisture behavior in relation to cotton.

A further important factor is that of abrasion resistance. In this connection it is known that different textile fibres have different fibre strengths for example:-

cotton	2,6-4.3 g/tex
viscose rayon	1.8-3.0 g/tex
polyamide	3.5-6.0 g/tex
modacrylic	2.1-3.0 g/tex
polyester	4.0-6.0 g/tex

The strength of a fibre which is conventionally tensile tested in the longitudinal direction, is not the only strength aspect which is important with regard to the wearability of a fabric. The strength of a fibre in cross section is also important.

The abrasion resistance of a fabric against wear is a complex combination of the fibre strength in longitudinal and cross-sectional directions. The prediction of strength characteristics of the fibres needed to withstand abrading forces is also complex. The fabric geometry which influences the way and the quantity of fibres from the warp and/or weft yarn that are attacked by the abrading forces is also of importance in regard to the abrasion behavior of a fabric.

It is known that by blending fibres with different strength characteristics the abrasion resistance of the

resulting fabric is not the simple arithmetic mean of the strengths of the separate fibre components.

Due to wearout of the "poorest" fibre the abrasion resistance follows often the strength of the weakest fibre. Intimate blending can upgrade this effect but mostly two-folding or twining of two single yarns is necessary to achieve a real effect.

Without explanation, it has surprisingly been found that the intimate blending of different fibres can result in fabrics of single yarns which have sufficient abrasion resistance for heavy wear.

The present invention is also concerned with the formation of a fabric having delayed flammability using single yarns spun from an intimate blend of fibres of which 25-35% are cotton fibres 35-55% are fibres which are much more resistant to abrasion than cotton and 20-30% are fibres which are more resistant to abrasion than cotton, the formation being such as to result in a fabric having an abrasion resistance which is generally better than the abrasion resistance of fabrics made of cotton.

Preferably, in this case the blends of samples G to K may be regarded as being suitable in relation to the property of abrasion resistance. As a further example of a delayed flammability material also having good abrasion resistance is a blend incorporating 30% cotton fibres, 40% modacrylic fibres of nearly cotton fineness (1.4-2.2 dtex/38-40) and 30% polyamide fibres of nearly cotton fineness (1.4-2.2 dtex/38-40mm).

In view of user's attitudes to the wearing of clothing in other than acceptable colours the colouration of such flame resistant materials is a very important

consideration in relation to normal use and acceptability in the market place. In other words, the colouration of the materials is a factor which has to be taken into account when formulating fabrics. Because of this factor various methods are proposed which result in even colouration of the fabric, i.e., involved in piece dyeing of the fabric or in using inherently coloured fibres (solution or dope dyed). If a special patterning is required, for example, as may be involved in camouflage patterning to protect the wearer against ready recognition or reconnaisance actions of others colouration by printing has to be possible. It is important to realise that every type of fibre has its own possibility of or impossibility of colouration by piece dyeing or printing. If for reasons above mentioned a blend of different fibres has to be used for particular purposes, for instance, fire resistant accompanied by selected ones or all of the aforementioned conventioned desirable factors of conventional clothing the common printability of the combination of fibres has also to be a taken into account.

Thus, a still further aspect of the invention is a material formed from an intimate blend of fibres of which at least 65% are cellulosic fibres i.e., cotton plus fire retardant viscose and the remaining fibres of the blend are polyamide fibres thereby resulting in an intimate blend of fibres which can be printed with one type of dye-system which equals systems used for printing 100% cotton.

In practice, the above mentioned Sample J relating to a blend consisting of 30% cotton fibres, 40% fire retardent viscose fibres of nearly cotton fineness 30% polyamide fibres of nearly cotton fineness can provide a "delayed flammability" fabric which is particularly suitable for printing.

It is to be understood that the forgoing discussions about fabrics are not restricted to woven fabrics since the principles of the invention can be applied to knitted, non woven and other types of fabric forming processes.

CLAIMS

1. A textile material, incorporating at least three components, in which a first and a second are flammable and a third is uninflammable, and in which said flammable components together provide between 50% and 75% of the total, with one of the flammable components providing at least 15% of the total, the components being so inter-related that the textile material exhibits delayed flammability characteristics.

2. A textile material as claimed in claim 1, wherein the flammable and inflammable components are so additionallly inter-related to each other that the textile material formed therefrom has predetermined moisture characteristics.

3. A textile material as claimed in claim 1 Or 2, wherein the flammable and inflammable components are so additionally inter-related that a textile material formed therefrom has an abrasion resistance that is the same as or better than that of cotton.

4. A textile material as claimed in claim 1,2 or 3, wherein the flammable and inflammable components are so additonally inter-related that the material is colour printable by means of printing systems suitable for the printing of 100% cotton material.

5. A textile material as claimed in any of claims 1 to 4, wherein the flammable and inflammable components include cellulosic materials to an amount of at least 65%.

6. A textile material as claimed in any of claims 1 to 4, and wherein the first flammable component is cotton in an amount of between 15 to 50% the second flammable component is nylon in an amount of 0 to 50%, and the inflammable component can be either viscose FR, modacrylic or flame retardent polyester or a combination of these three in an amount of 25 to 50% of the total.

7. A textile material as claimed in any one of claims 1 to 4 and claim 6, and wherein the first flammable component is cotton in an amount of between 25 to 35%, the second flammable component is nylon in an amount 25 to 40%, and the inflammable component can be either viscose FR or modacrylic or a combination of both in an amount of 25-50% of the total.

8. A material as claimed in any of claims 1 to 4 and claim 6 or 7, and wherein the first flammable component is cotton in an amount of 30%, the second flammable component is polyamide in an amount of 30%, and the inflammable component can be either viscose FR or modacrylic or a combination of both in an amount of 40% of the total.

9. A textile material as claimed in any of the preceding claims, wherein said first, second, third, components can be in the form of fibres, filaments, slivers, roving and yarns.

10. A textile material as claimed in any of the preceding claims in the form of a yarn, woven fabric, knitted fabric or non-woven fabric.

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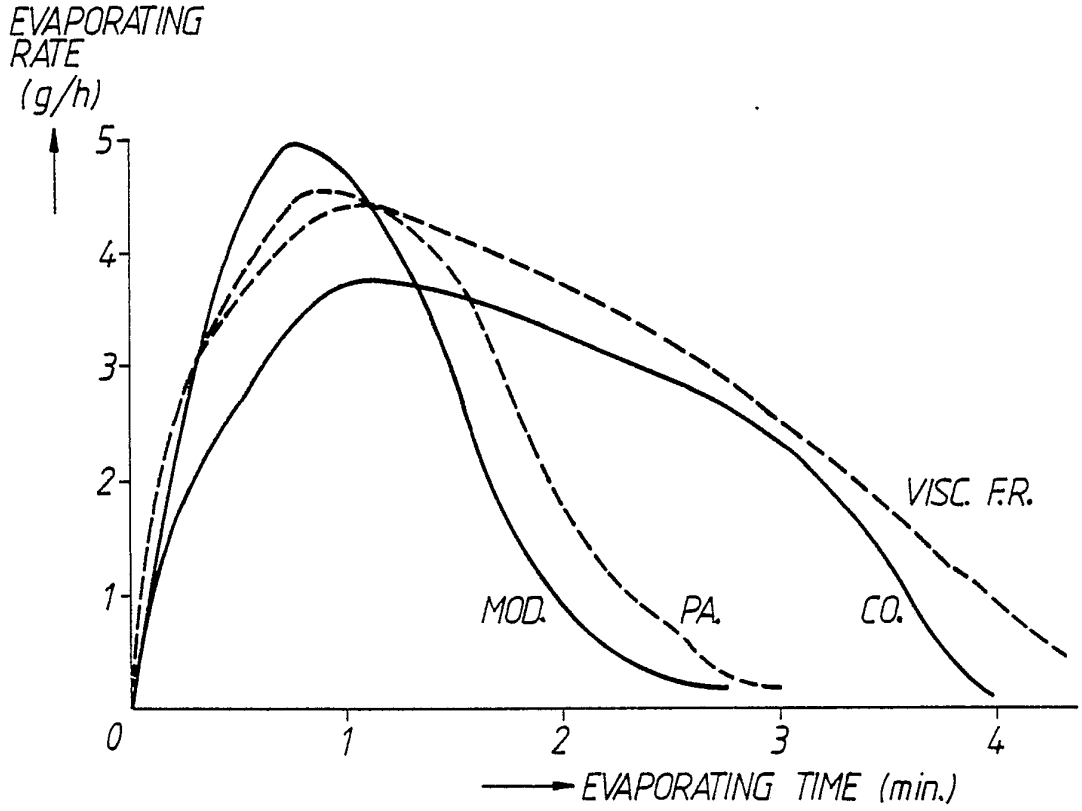
EVAPORATING
RATE
(g/h)
5
4
3
2
1
0
1
2
3
4
VISC. F.R.
MOD.
PA.
CO.
EVAPORATING TIME (min.)

FIG. 1.

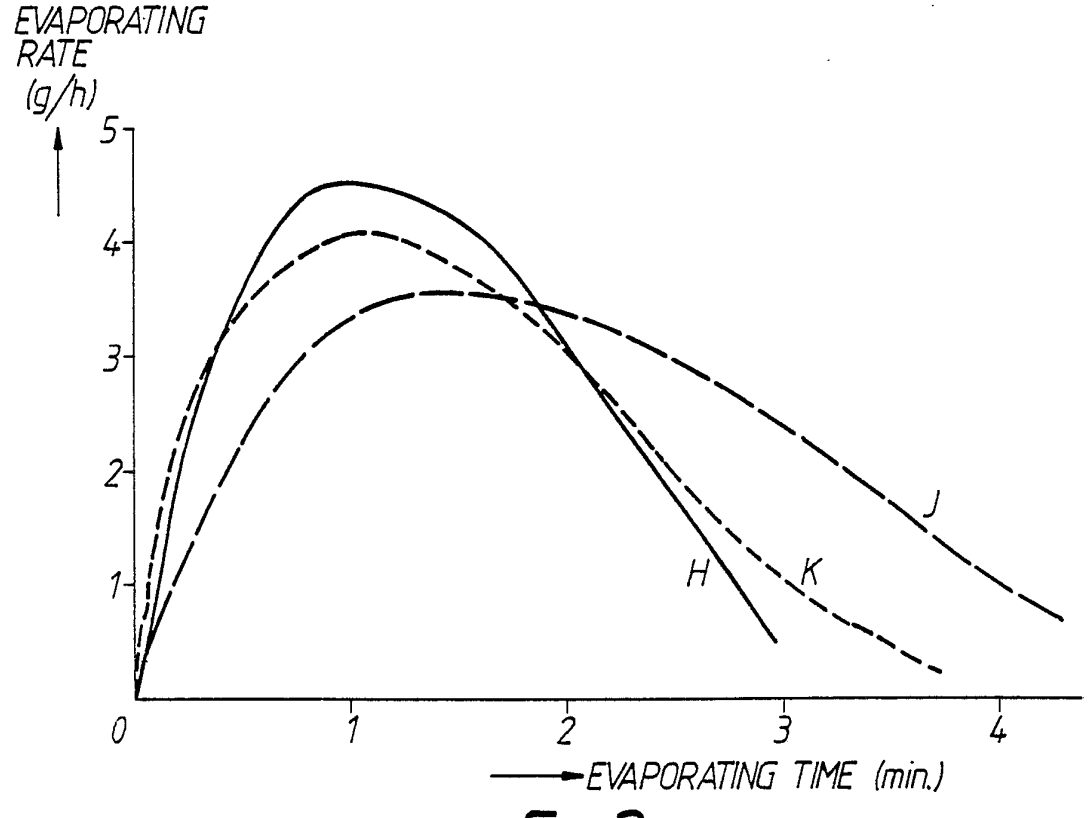
EVAPORATING
RATE
(g/h)
5
4
3
2
1
0
1
2
3
4
J
H
K
EVAPORATING TIME (min.)

FIG. 2.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 86/00754

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: A 41 D 31/00; A 62 B 17/00; D 03 D 15/12

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	A 41 D; A 62 B; D 03 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	DE, A, 3115786 (VERSEIDAG-INDUSTRIE-TEXTILIEN) 11 November 1982 see page 5, paragraphs 5,6; page 6, paragraphs 1-3; page 7, the last three paragraphs; figure 4 --	1,3,9,10
A	US, A, 4001477 (THE CARBORUNDUM CO.) 4 January 1977, see column 1, lines 20-27,61-68; column 2, lines 1-15, 26-50; column 4, lines 54-68; column 5 --	1
A	Manufacturing Clothier, volume 64, no. 3, March 1983, (London, GB), M. Disher: "The quest for FR of a study of textile flammability", see pages 39,41,43,45, 49,51 --------	

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
3rd April 1987	14 MAY 1987
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	L. ROSSI

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 86/00754 (SA 15504)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 14/04/87

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 3115786	11/11/82	None	
US-A- 4001477	04/01/77	US-A- B378760	09/03/76