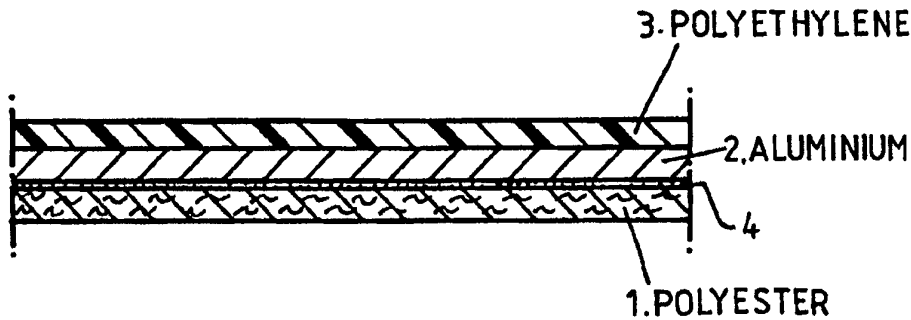




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification <sup>6</sup> : A62D 5/00, B32B 15/20, A62B 17/00</p>	<p>A1</p>	<p>(11) International Publication Number: <b>WO 97/00710</b> (43) International Publication Date: 9 January 1997 (09.01.97)</p>
<p>(21) International Application Number: PCT/BE95/00060 (22) International Filing Date: 22 June 1995 (22.06.95) (71)(72) Applicant and Inventor: HEYNDRICKX, Bruno [BE/BE]; Vogelheide 15, B-9050 Gent (BE). (74) Agents: LEMAIRE, Guy et al.; Bureau Vander Haeghen S.A., Rue Colonel-Bourg 108A, B-1040 Brussels (BE).</p>		<p>(81) Designated States: AM, AU, BB, BG, BR, BY, CA, CN, CZ, EE, FI, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LV, MD, MG, MN, MW, MX, NO, NZ, PL, RO, RU, SD, SI, SK, TJ, TT, UA, US, UZ, VN, ARIPO patent (KE, MW, SD, SZ, UG), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report.</i></p>

(54) Title: PROTECTIVE CLOTHING AGAINST TOXIC COMPOUNDS



(57) Abstract

A ready-to-wear protective clothing is suitable against toxic or noxious compounds, provided: it consists of an aluminium layer (2), e.g. a complex layer of aluminium foil (2), finished with a polyester layer (1) and a layer of analogous organic compounds (polyethylene) (3) glued by means of water polyvinyl alcohol adhesive seal (4) or analogous; it includes an autonomous gasmask comprising an oxygen-source and a cartridge comprising a CO<sub>2</sub> absorber of the exhaled carbon dioxide; it is disposable after single use.

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PROTECTIVE CLOTHING AGAINST TOXIC COMPOUNDS

The present invention relates to a ready-to-wear protective clothing against toxic or noxious compounds and viruses and to a stratified material suitable for said clothing. It finds its main application in chemical and pharmaceutical industries, particularly in biological laboratories specialized in the production of vaccines.

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The protective clothing are made of a stratified protective material which consists of different layers. A protection may only be obtained if at least one of the layers is completely impermeable to gases and liquids and if this layer can offer chemical resistance over a longer period of time against the penetrating attacking compounds.

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Such material is fit for the production of ready-to-wear labour clothing.

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The invention relates to a protective suit in one piece, comprising a protective cap, a protective apron, gloves and coat for workers who are exposed to hazardous environments.

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The invention concerns also a method of operation for the preparation of a stratified protective material against toxic compounds, especially chemical, microbiological and virological.

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Based on the document BE-A-880.768, there exists a protective material for protective suits which consists of several layers : water resistant, non-combustible, non-flammable, insulating, impermeable to wa-

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ter and/or to gases.

The material consists of a layer of textile fabric such as treated cotton and analogous material, an intermediate layer of mineral fibres and/or an absorbing carbon layer, a final layer of insulating and permeable foam plastic the cells of which are provided with an absorbing carbon layer. Quite often these suits have little effect against certain penetrating industrial pharmaceutical and war gases, to such an extent that the user no longer is protected, not even for a short time.

The present invention intends to correct these drawbacks and introduces a stratified protective material for producing ready-to-wear protective clothing against toxic or harmful compounds, offering virtually complete protection. The protective material consist of several layers, such as an organic chemical layer or a layer of analogous fabrics and is distinguished because one of these layers is an aluminium layer, optionally finished with a layer of organic chemicals.

In a particular embodiment, the ready-to-wear protective clothing includes an autonomous gasmask comprising an oxygen-source and a cartridge comprising a CO<sub>2</sub>-absorber of the exhaled carbon dioxide. It comprises usefully warning systems controlling the oxygen-supply and the carbon dioxide. The CO<sub>2</sub>-absorber is preferably lime.

A particularity of the invention states that the aluminium layer consists of an extremely thin layer of aluminium foil. The aluminium layer has a minimum thickness of about 8 micron.

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In a further development stage of an application form in accordance with the invention, the aluminium foil is glued onto a piece of fabric, or organic polymers.

5

As adhesive the use of a polyvinyl alcohol adhesive or analogue is recommended.

The aluminium layer gives us a number of advantages, such as in the area of permeability to gas, chemical, microbiological or virological contamination. In addition the aluminium layer offers excellent vapour inhibiting features and possesses the property of reflecting warmth

15

The invention also concerns a method to produce the above described protective material.

The fabric layer is preferably heated to approximately 45°C together with the aluminium foil; after that both materials are glued together by means of water polyvinyl alcohol adhesive or analogous.

These and other characteristics and particularities of the invention are hereafter demonstrated by the following accurate description of a specific method of execution, by means of the illustration enclosed, in which the only figure is a cross section of a protective material in accordance with the invention.

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On a first surface of the layer 1 : polyester : ± 12 micron, a thin aluminium layer 2 of minimum about 8 micron is applied, by gluing an aluminium foil onto it by means of a water polyvinyl alcohol adhesive seal 4. The aluminium foil can already be adhered in

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advance to an existing plastic film 3 polyethylene  
(± 70 micron).

5 The reflecting properties of aluminium for  $\alpha$ -  
and  $\beta$ -rays make that aluminium protective material is  
suitable for the protection against such radioactive  
isotopes.

10 The resistance of aluminium foil against  
madness and further oxidation is excellent.

15 In the scientific research by comparison with  
any type of textile fabric, plastic compounds and  
others, the conclusion has been reached that an alumi-  
nium layer, even a very thin one, offers the best pro-  
tection, among other things : against isocyanates, ex-  
tremely aggressive substances such as mustard gas; ex-  
tremely penetrating substances, such as cyanides, myco-  
toxins, phosphorus, organic phosphoric compounds, fire  
20 bombs, lighting bombs, polymers, pyrolysis products,  $\alpha$ -  
and  $\beta$ -rays, radioactive isotopes and radiation, etc.

25 A conclusion from experimental scientific re-  
search is that aluminium suits, produced with a protec-  
tive material which consists of an aluminium layer 2,  
finished with organic chemical layers 1 and 3 or analo-  
gous compounds, offer almost complete protection. This  
depends among other things of the acidity of the aggres-  
sive substances.

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In any case these suits offer a far better  
protection, they are much lighter to wear and have the  
great advantage, because of the low cost price, that  
they can also be used as a disposable suit for single  
35 use.

That way it became clear that certain impure gases, such as mustard gas, are a lot more impregnating and penetrating than pure gas.

5 Comparative research of protective suits made of different fabrics is grouped in the following charts. The tests concern the resistance of the investigated fabrics against Yperite (mustard gas 100 %). Each test was carried out three times. The average time is indicated in the last column, together with an appreciation of the efficiency of the protection.

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CHART : RESISTANCE TO YPERITE (100 %)

N°	TEST SUBSTANCE INVESTIGATED	TIME (RESISTANT TO YPERITE 100 %)			AVERAGE TIME + REMARK
		First measurement	Second measurement	Third measurement	
1	Protective clothing cotton (laboratory overall)	5 min.	< 5 min.	< 5 min.	-
2	Polyethylene plastic + PTFE-spray	4 hours	4 hours	4 hours	± 4 hours
3	High density	60 min.	45 min.	50 min.	± 1 hour
4	Low density polyethylene 50µm	1 hour	45 min.	30 min.	± 45 min.



N°	TEST SUBSTANCE INVESTIGATED	TIME (RESISTANT TO YPERITE 100 %)	AVERAGE TIME + REMARK
5	Low density polyethylene LDPE 80 µm	1 hour 30 min. 55 min.      1 hour	± 1 hour
6	Polyamide 50µm (PA)	1 hour      2 hours	more than 1 hour
7	HDPE 40 µm + spray High density polyethylene (fluorinated hydrocarbon)	2 hours      1 hour	more than 1 hour
8	PVC-bag (bin bag)	20 min.      10 min.	15 min.
9	Aluminium (foil) (thickness = 8 µm)	> 1 week      > 1 week	> 1 week +++

N°	TEST SUBSTANCE INVESTIGATED	TIME (RESISTANT TO YPERITE 100 %)	AVERAGE TIME + REMARK
10	Al protective foil (plastic + Al-layer - plastic)	12 hours	10 hours +
11	Al bags  aluminium layer plastic layer Thickness : 8 µm Al	> 1 week	> 1 week > 1 week +++

TEST SUBSTANCE INVESTIGATED	TIME (RESISTANT TO CONCENTRATIONS OF CHEMICALS ACCORDING TO NATO and EU 141 REQUIREMENTS)	AVERAGE TIME + REMARK
N°		
12 Al protective foil (plastic + Al-layer + plastic)	> 1 month > 1 month	> 1 month > 1 month
		+++

Such material as described above is impermeable to any kind of low energetic particles. As such the material is impermeable to bacteria, spores and viruses.

5

It is also impermeable to wash or water vapour, implementing that bacterial contamination through transport in water is also avoided.

10

Scientific studies have proven that a complete toxicological decontamination of protective suits is practically impossible. This disposable suit for single use gives an answer to said problem.

C L A I M S

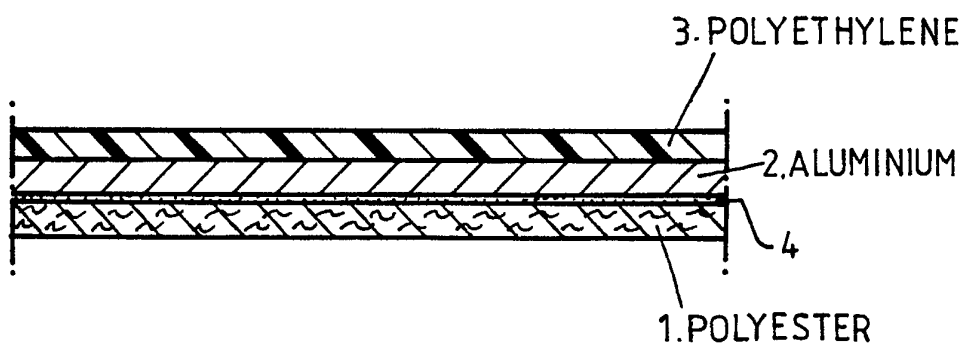
1. Ready-to-wear protective clothing against toxic or noxious compounds, especially chemical, micro-  
5 biological and virological compounds, made of a stratified protective material consisting of several layers which are by turns water resistant, non-combustible, non-flammable, insulating, impermeable to water and/or  
10 gases, characterized in that the layers are an organic chemical layer(1) or analogous fabric and that at least one of the layers is an aluminium layer (2), optionally finished with an organic chemical layer (1) or an organic fabric.
- 15 2. Ready-to-wear protective clothing according to claim 1, characterized in that it includes an autonomous gasmask comprising an oxygen-source and a cartridge comprising a CO<sub>2</sub> absorber of the exhaled carbon dioxide.
- 20 3. Ready-to-wear protective clothing according to claim 2, characterized in that it comprises warning systems controlling the oxygen-supply and the carbon dioxide.
- 25 4. Protective material characterized in that the aluminium layer (2) consists of an aluminium foil.
- 30 5. Protective material according to claim 4, with the property that the aluminium layer (2) consists of a glued aluminium foil or a complex aluminium foil (3).
- 35 6. Protective material according to claim 4 or 5, with the property that the aluminium layer (2) has

a minimum thickness of approximately 8 micron.

5 7. Protective material according to one of claims 3 to 6, characterized in that it is impermeable to any kind of low energetic particles, to bacteria, spores and viruses and also impermeable to water and water vapour so that bacterial contamination through transport in water is avoided.

10 8. Method in order to glue a stratified protective material according to one of the preceding claims, consisting of several layers, among which an organic chemical layer (1) or analogous fabrics, characterized in that the organic chemical layer (1), together with  
15 the aluminium layer (2) is glued together gluing both layers by means of a water polyvinyl alcohol adhesive seal (4) or analogous.

20 9. Application of a disposable single use protective clothing according to one of the claims 1 to 3, as protection against : isocyanates, mustard gas, cyanides, mycotoxins, phosphorus, organic phosphoric acid compounds, fire bombs, lightning bombs, polymers, pyrolysis products,  $\alpha$ - and  $\beta$ -rays, radioactive isotopes and radiation,  
25 tion, microbiological and virological agents.



## INTERNATIONAL SEARCH REPORT

International Application No

PC., BE 95/00060

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 6 A62D5/00 B32B15/20 A62B17/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 6 A62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BE,A,1 003 216 (HEYNDRIKX BRUNO) 14 January 1992	1,4-9
Y	see the whole document ---	2,3
Y	FR,A,2 646 781 (LEMASSON YVES) 16 November 1990 see page 2, line 28-31; claims ---	2,3
X	US,A,4 792 480 (FREUND PAUL X ET AL) 20 December 1988 see column 3, line 66 - column 4, line 35 see claims 7-9 ---	1,4-7
X	DE,A,43 37 014 (MAGER ROLF) 16 February 1995 see claims ---	4-6
	-/--	

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search

15 January 1996

Date of mailing of the international search report

12.03.96

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INTERNATIONAL SEARCH REPORT

International Application No  
 PL., BE 95/00060

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 214 321 (NUWAYSER ELIE S) 29 July 1980 see the whole document -----	4-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PL, BE 95/00060

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BE-A-1003216	14-01-92	NONE	
FR-A-2646781	16-11-90	NONE	
US-A-4792480	20-12-88	DE-A- 3829501 GB-A, B 2209706	23-03-89 24-05-89
DE-A-4337014	16-02-95	DE-U- 9309871 NL-A- 9401108	28-10-93 01-02-95
US-A-4214321	29-07-80	NONE	