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Bulletin 87/34(71) Applicant: **Grifoni, Sergio, Via Capolungo 2/A/6,
I-16167 Genova (IT)**(72) Inventor: **Grifoni, Sergio, Via Capolungo 2/A/6,
I-16167 Genova (IT)**(84) Designated Contracting States: **AT BE CH DE FR GB IT LI
LU NL SE**(74) Representative: **Porsia, Dino, Dr. et al, c/o Succ. Ing.
Fischetti & Weber Via Caffaro 3, I-16124 Genova (IT)**(54) **Shield against radiations.**

(57) A shield against ionizing radiations comprises at least one layer including one or more boron minerals and/or one or more lead minerals and/or directly derived products, which preferably constitute the inert or slightly active aggregate fraction of cement-based conglomerates (such as concrete or mortar). Galena and/or other lead minerals can be used for the shielding from γ rays, and colemanite and/or other boron minerals can be used for neutron shielding. Particular purpose additives will also be used. The family of compositions according to the invention will contain by weight 65–75% of floated galena, 5–10% of colemanite and 20–25% of binding agents and additives.

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Shield against radiations

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10 The present invention relates to a shield
against ionizing radiations, comprising at least one
layer consisting of a cement based conglomerate which
contains, as a substitute of the inert aggregate
fraction, one or more lead minerals and/or one or more
15 boron minerals and/or their directly derived products.

 The advantage of using the above mentioned
minerals or their directly derived products resides in
the fact that same are more easily available than
20 industrial chemical products, and with physical pro-
perties (grain size and distribution, surface roughness,
etc.) close or more similar to the ones of the inert
aggregates used in cement-based concretes and mortars.

25 The reason for using lead minerals in the
shield, than baryta or iron minerals, or manganese
minerals is that, for equal weights, lead is much more
efficient in the shielding against X-rays and γ -rays
than any other readily available element. The higher
30 cost of lead as a commercial metal (in comparison with

1 iron or manganese) is abundantly compensated by the
higher efficiency of the shield thus obtained.

5 According to a preferred embodiment of the
invention, a particular family of shielding compositions
has been found to be well suited to constitute the
biological shield of a nuclear reactor (particularly
a Boiling Water Reactor).

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According to the invention, one layer of cement-
based conglomerate or mortar contains a composition
belonging to the following family:

15	Galena	65-75 % of weight
	Colemanite	10-5 % of weight
	Binding agents	15-20 % of weight
	Additives	5-10 % of weight

20 The mixture obtained with the above listed
materials is then mixed with water for immediate use.

The additives in the above composition have a
very important role, in consideration of the fact that
25 the shielding material must satisfy a number of
additional needs, i.e.:

- to remain fluid for a sufficient time after
preparation;
- to be poured or pumped into the compartments
30 of the shielding structure;

- 1 - to expand inside the compartments to fill
 small voids;
 - not to shrink during the hardening process;
 - not to corrode the walls of the shielding
5 structure.

Basic additives are: sulphonates, chelate forming agents, aerating agents, expanding agents.

10 Moreover, in order to avoid problems at the construction site, the wet mixture must not have a specific weight much higher than the weight of ordinary concrete. The specific weight of the mortar must be therefore comprised between 2.5 and 3.5 g/cm³.

15 In order to obtain the above mentioned results, floated galena (i.e. galena obtained with flotation methods) can be used, which presents a grain distribution comprised, by way of example, between 5 and 80 μ . To
20 the floated galena a small quantity of silver can be added.

 The shielding layers thus obtained are very effective against γ , β and α rays, as well as
25 against fast and slow neutrons. The efficiency against neutrons will be the best if all the water is kept in the shield. The efficiency is still very good however if the shield is allowed to dry (in this case just the reaction, hydratation and adsorbed water is kept).

- 1 The final shield will contain:
- lead, at least 38 % of weight;
 - boron, at least 0.6 % of weight;
 - hydrogen, at least 1.5 % of weight (wet shield),
- 5 or
- hydrogen, at least 0.7 % of weight (dry shield).

 The shield will be preferably maintained in
wet conditions.

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 Of course the invention is not limited to the
above described preferred embodiment, but it can be
broadly varied and modified, particularly as for what
concerns the equivalents of the various components.

15 Thus, for example, the lead minerals may comprise,
besides galena, also cerussite or anglesite, while the
boron mineral may comprise, besides colemanite, also
borax or ulexite.

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CLAIMS

1) A shield against ionizing radiations, characterized by the fact that it comprise at least
5 one layer constituted by a cement-based conglomerate or a cement-based mortar containing, in substitution of the inert or slightly active aggregate fraction, a mixture of one or more boron and/or lead minerals.

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2) A shield according to claim 1 characterized by the fact of further comprising a mixture of additives such as sulphonates, chelate forming agents, aerating agents and expanding agents.

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3) A shield according to claim 1, characterized by the fact that the lead minerals comprise galena and/or cerussite and/or anglesite.

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4) A shield according to claim 1, characterized by the fact that the boron minerals comprise colemanite and/or borax and/or ulexite.

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5) A shield according to claim 3, characterized by the fact that the lead mineral consists of floated galena containing optionally a small quantity of silver.

6) A shield according to claim 2, characterized by that fact of comprising, by weight:

- Galena: 65-75%;

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- Colemanite: 10-5%;

- 1 - Binding agents: 15-20%;
 - Additives: 5-10%;

5 7) A shield according to claim 1, characterized
by the fact that after the addition of water it will
present a density comprised between 2.5 and 3.5 g/cm³.

10 8) A shield according to claim 1, characterized
by the fact that the cement-based mortar prepared with
addition of water will retain all or almost all of
the added water.

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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.4)
X	ATOMKERNENERGIE, vol. 3, no. 3, March 1958, pages 101-108, Verlag Karl Thiemig AG, Munich, DE; T.JAEGER: "Beton in der Strahlenschutztechnik" * Page 101, right-hand column, lines 38-43; page 102, right-hand column; page 103, left-hand column, third paragraph; figure 28; page 105, table 6c *	1	G 21 F 1/04
A	IDEM	2-4, 7, 8	
A	--- US-A-3 238 148 (PHILIPS S.OSBORNE) * Column 3, lines 18-51; column 4, lines 5-27; column 6, lines 34-58 *	1, 2, 6	
A	--- FR-A-1 398 490 (WILLIAM CORNELIUS HALL) * Claims 1-4 *	1, 4, 6	G 21 F 1/00
A	--- GB-A-2 004 406 (THE MARCONI CO.) * Page 1, lines 65-82 *	1, 3	

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25-05-1987	Examiner JANDL F.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	