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DRY EXOTHERMIC COMPOSITION CONTAINING FIBROUS MATERIAL HAVING OXIDIZER SALT ABSORBED THEREIN

Edward John Jago, Cleveland, Ohio, assignor to Foseco Trading A.G., Graubunden, Switzerland, a Swiss company

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This invention relates to exothermic compositions which contain an oxidizable substance and an oxidizing agent therefor such that when the composition is heated a reaction between the said oxidizable substance and the oxidizing agent takes place with the generation of considerable amounts of heat. Such compositions are referred to herein, for brevity, simply as "exothermic compositions."

A particular form of such composition which is of wide industrial application is a so-called aluminothermic composition, wherein the oxidizable material is finely divided aluminium. The oxidizing agent may be a mixture of several substances, e.g. iron oxide, manganese dioxide and/or alkali metal nitrates and chlorates. Commonly, such compositions also contain a filler, e.g. a refractory substance such as grog, sand, chamotte or furnace aggregate.

Among the principal uses of such compositions are their use in providing local heat in the operation of casting molten metals. In this connection, they may be employed to delay solidification of the head metal in a casting mould or in a hot-top associated therewith, e.g. they may be provided as loose powders or preformed slabs applied to the surface of the head metal or as linings to the ingot head or hot-top. They may also be used as a substitute for "padding" in positions in a casting mould where it is important to delay solidification of the cast metal.

A second important use of such compositions is in the heat-treatment of welds to effect a stress-relief, normalizing or annealing of the metal in the region of the weld, the composition being fired to provide the heat for the treatment and allow to burn out and cool down in situ.

Examples of the use of such compositions for foundry purposes are given in British Patent No. 627,678. Examples of the use of such compositions for the heat treatment of welds are given in British Patent No. 898,232. Numerous other applications of such compositions have been described and are well known from the literature.

It has now been found that especially satisfactory exothermic compositions may be made by employing as a dispersed ingredient of such compositions an organic fibrous material e.g. an animal or vegetable fibrous material, a fibrous constituent of the composition having adsorbed thereto, or absorbed therein, an oxidizing agent. Due to the distribution of the oxidizing agent on the fibrous material and the dispersion of that material throughout the composition the oxidizing agent is used to optimum effect.

According to a first feature of the present invention, therefore, there is provided an exothermic composition comprising in intimate admixture, an oxidizable substance, oxidizing agent therefor and an organic fibrous material, a fibrous constituent of the said composition having adsorbed thereto, or absorbed therein, at least a portion of said oxidizing agent.

Generally oxidizing agent will be adsorbed to or absorbed in the organic fibrous material just referred to, but the invention includes compositions which additionally contain other fibrous materials e.g. a fibrous refractory such as asbestos, in which an oxidizing agent may be adsorbed to such other fibrous material.

According to a specific and preferred form of the invention the exothermic composition comprises, in intimate admixture, finely divided aluminium and cellulose fibre, the latter having adsorbed thereto, or absorbed therein, an oxidizing agent, optionally also containing a granular or fibrous refractory filler.

Referring now in greater detail to the ingredients of the compositions:

Oxidizable material.—This, as noted above, is preferably finely divided aluminium. It may, however, be one of many other substances which have been suggested for the purpose, e.g. magnesium, carbon or silicon, or may be an admixture of such substances.

It is not necessary however to employ a pure oxidizable material. Thus one convenient source of aluminium is "ball-mill dust" and this has the immediate advantage of cheapness.

Ball-mill dust is the material obtained as a result of ball-milling aluminium dresses obtained from the surface of baths and ladles containing molten aluminium. When these dresses are ball-milled the non-metallic parts of the dress are reduced to a fine powder whilst the metallics present remain as large sized particles. After the ball-milling operation the contents of the mill are passed over a 10 mesh screen, when the finely powdered non-metallics fall through and the metallic parts pass over. The powder which falls through the mesh is known as ball-mill dust and this can contain from 5 to 50% of metallic aluminium. Apart from the metal present the powder contains alumina and salts such as sodium and potassium chlorides and fluorides.

Oxidizing agents.—The oxidizing agent may include the conventional iron oxide or manganese dioxide. The oxidizing agent must, however, at least in part, be constituted by a said agent which is adsorbed to or absorbed in, fibrous material present in the composition. Accordingly, it is preferred, from the standpoint of convenience, to employ a water-soluble oxidizing agent, e.g. a nitrate or chlorate, which can be absorbed in, or deposited on, the fibrous material from aqueous solution.

Animal or vegetable fibrous material.—This material is preferably cellulose fibre but other fibrous materials, and particularly such as readily absorb aqueous liquid, e.g. sawdust, wood fibre, peat or the like may be employed.

Other ingredients.—Other ingredients may optionally be present, e.g. fibrous or non-fibrous refractory fillers, such as asbestos, glass fibre, slag wool, grog, sand, chamotte, furnace aggregate or the like. When the reducible material is finely divided aluminium it is sometimes desirable to include a proportion e.g. 0.1 to 10% by weight of a fluoride. This is described in particular, in British Patent No. 627,678 and any of the fluorides herein mentioned may be employed.

It is also generally necessary to include a binder substance to hold the particulate composition to a shaped form. Suitable binders are sulphite lye, gums, bentonite, or natural or synthetic resins.

The compositions may vary widely in composition according to the specific use for which they are required. Broadly, the following represents a very useful range of compositions by weight:

	Percent
Oxidizable substance (e.g. aluminium)	5 to 40
Oxidizing substances	5 to 25
Organic fibrous material	0.25 to 20
Refractory fillers	20 to 80
Fluoride (when the oxidizable substance is aluminium)	0.25 to 10
Binder	1 to 10

The foregoing compositions may be made by mixing the specified ingredients together in appropriate proportions, the cellulosic or other fibrous material taking up

oxidizing agent by adsorption or absorption during the mixing process.

The inclusion of fibrous materials in the compositions may be expected to improve the shock-resistance and general mechanical strength of shaped bodies of the compositions but it has been found that the normal means employed for forming pre-formed shapes of such compositions, such as hand-ramming, jolting, squeezing and shooting, do not generally allow the fibrous ingredient to "flow" into the desired shapes so that the potential advantage of the fibrous ingredient is not fully realized.

It is a known technique in the manufacture of articles from compositions based essentially on cellulosic fibre pulp to form an aqeueous slurry of the fibre pulp, optionally containing other solid ingredients and containing a proportion of a binder, charge the slurry into a vessel having a wall, usually the top wall, formed of a wire mesh, positioning the vessel so that the slurry lies against the wire mesh and allowing or causing the liquid medium of the slurry to percolate through the mesh, which latter retains the solid constituents of the slurry. Generally, air pressure is applied to the surface of the slurry so as to drive it towards the mesh, and to force the liquid medium through the mesh (or a vacuum may be appropriately applied to obtain the same result) leaving behind a compacted body of the solid constituents of the slurry, which body is shaped according to the configuration of the wire mesh.

The binder is usually dissolved in the liquid medium of the slurry and through a substantial proportion passes through the mesh without, therefore, exerting any binding action, sufficient remains in the liquid in the wet compacted mass to exert the necessary binding action when the shaped mass is removed from the mesh and oven-dried.

The foregoing method has been proposed for the production of preformed linings for casting moulds and hot tops for ingot moulds. In such a case the composition may contain 2–20% by weight of organic fibrous material, e.g., paper pulp or waste paper, mechanical pulp or chemical pulp, 4–10% by weight of a binder and the remainder refractory material, e.g. quartz, quartzite, sand, or inorganic silicate or calcined dolomite or silica flour. Advantageously, at least a part of the refractory may be itself fibrous, e.g. as asbestos fibre.

Various binding materials have been proposed, e.g. a glue derived from natural sources, for instance, a cellulosic glue, or one prepared synthetically, for instance, as a synthetic resin, or being an inorganic material such as water glass.

An alternative and particularly desirable binding agent for this process is a thermosettable binding agent such as a phenol-formaldehye resin of the novolak type.

It might have been thought that this technique would have no application in the present invention where, using such a cellulose pulp, it is desired to impregnate it or deposit on it a water soluble oxidizing agent such as an alkali metal nitrate or chlorate but, in fact, it has been found that the method is especially suitable for the purpose. In carrying out the method the water soluble oxidizing agent is dissolved in the slurry. A proportion of it passes out with the effluent (from which it can be recovered) but a sufficient proportion of it is retained obsorbed in the cellulosic fibre so that, in the dried product, the oxidizing agent is substantially uniformly dispersed in or on the fibrous cellulosic material.

It is also to be noted in this connection that where any of the ingredients are water-soluble, e.g. a water soluble fluoride may be present, it may be desirable to start with larger amounts of them than are ultimately necessary, to allow for the portion which will pass out with the effluent.

According therefore to a further feature of the invention shaped solid bodies of exothermic compositions according to the invention are produced by a process which

comprises forming a slurry of the specified ingredients in an aqueous medium, the ingredients including a water-soluble oxidizing agent at least partly dissolved in the said aqeuous medium, charging the slurry into a vessel having a wall formed of a wire mesh, positioning the vessel so that the slurry lies against the wire mesh and allowing or causing the liquid medium of the slurry to percolate through the mesh, while retaining the solid constituents of the slurry on the mesh, removing the resulting shaped and compacted body from the mesh and drying it.

The following example will serve to illustrate the invention.

Example

A slurry is made of the following ingredients:

	Parts by weight
Aluminium grindings (−16 mesh)	15
Aluminium foil (pulverized to −16+60)	10
Manganese dioxide	10
Sodium nitrate	10
Cryolite	5
Cellulose fibre (scrap newsprint)	6
Asbestos fibre	1
Silica flour	38
Phenol formaldehyde novalak resin (−300 mesh)	5
	100
Water	300

The slurry is formed to a shaped slab, by the technique referred to above, and the slabs are dried out.

The products ignite easily in a hot flame and in contact with molten copper, burning smoothly and with generation of great heat.

I claim as my invention:

1. In an exothermic composition comprising an intimate admixture of an oxidizable element and a water-soluble oxidizing agent therefor, the improvement which comprises the presence of an organic water-permeable fibrous material, at least a portion of said oxidizing agent being absorbed in said fibrous material.

2. An exothermic composition comprising in intimate admixture an oxidizable element selected from the class consisting of aluminum, magnesium, carbon and silicon, a water-soluble oxidizing agent therefor selected from the class consisting of nitrates and chlorates, and an organic water-permeable fibrous material, at least a portion of said oxidizing agent being absorbed in said fibrous material.

3. In the exothermic composition of claim 1 wherein the organic water-permeable fibrous material is selected from the class consisting of cellulosic fiber, sawdust, wood fiber, and peat.

4. An exothermic composition according to claim 2 wherein the oxidizable element is aluminum.

5. An exothermic composition according to claim 2 wherein the organic water-permeable fibrous material is selected from the class consisting of cellulosic fibre, sawdust, wood fibre and peat.

6. An exothermic composition according to claim 2 which further comprises a refractory filler.

7. An exothermic composition according to claim 2 which further comprises a refractory filler selected from the class consisting of asbestos, glass fibre, slag wool, grog, sand, chamotte and furnace aggregate.

8. An exothermic composition according to claim 2 wherein the oxidizable element is aluminum and the composition comprises 0.1 to 10% by weight of a fluoride.

9. An exothermic composition according to claim 2 which comprises a binding agent for the ingredients of the composition.

10. An exothermic composition according to claim 2

which comprises the following ingredients in the proportions by weight indicated:

	Percent
Finely divided aluminum	5–40
Water soluble oxidizing agent	5–25
Water permeable organic fibrous material	0.25–20
Refractory filler	20–80
Fluoride	0.25–10
Binder	1–10

at least part of the said oxidizing agent being absorbed the said organic fibrous material.

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BENJAMIN R. PADGETT, *Primary Examiner.*

DAVID L. RECK, CARL D. QUARFORTH, *Examiners.*

R. O. DEAN, S. J. LECHERT, JR., *Assistant Examiners.*