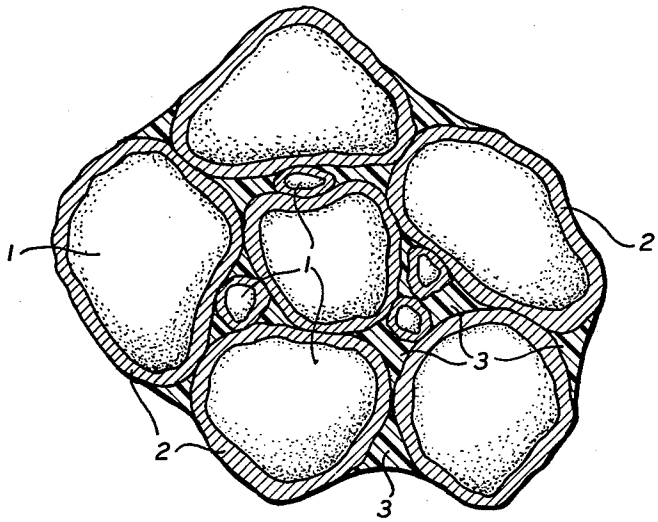
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PAVEMENTS AND METHOD OF MAKING THE SAME

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PAVEMENTS AND METHOD OF MAKING THE SAME

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This invention relates to treated bituminous pavements and aims to provide a semi-rigid pavement structure that is adapted to furnish a durable and waterproof surface for the ground in areas such as airfield runways, roads, parking lots, terraces, shop and factory floors, sports grounds, dams, canal banks and the like.

In the past, pavements that have been designed for use in locations wherein a pavement embodying our invention can be employed with benefit have been of two general types. Of these, one, which is made with bituminous material, is flexible in nature; and the other which is made with hydraulic cement is rigid. Each of these past types of pavement has advantages and disadvantages. In the flexible type of pavement the plasticity of the bituminous material (tar or asphalt) allows the pavement to bend without cracking. However, such a pavement may become soft and consequently does not withstand heavy static loads or the shearing action of metallic wheels. Moreover, such a pavement is usually not completely waterproof as it contains a certain percentage of voids. In the case of rigid pavements made from Portland cement, for example, the surface remains hard and waterproof but under the combined actions of traffic, changes in the condition of the ground upon which it is laid, temperature changes and shrinkage, it will inevitably develop cracks. Furthermore, such rigid pavements are laid in slabs and the joints between slabs invariably cause difficulty.

Attempts have been made in the past to treat pavements of the bituminous type with substances such as hydraulic cement so that the disadvantages that have been possessed by untreated bituminous pavements might be overcome. One such attempt has consisted in covering the bituminous pavement with a layer of hydraulic cement; another such attempt has consisted in attempting to impregnate a normal bituminous pavement with a thin mortar of hydraulic cement, hydraulic chalk and the like. Neither of these expedients has proved satisfactory. In the first case, the results are generally comparable to those characterizing the rigid pavements referred to above. In the second case, a semi-rigid pavement is provided which can undergo slow deformation without cracking and the surface resistance to shearing is improved. However, a grout of very low viscosity is required to enable it to penetrate the thin voids and channels of the bituminous pavement, the quantities of water necessarily employed seriously impair the strength of the hardened grout, after setting, and by virtue of shrinkage micro-fissures therein the impermeability of the pavement to water and solvents is reduced.

We have discovered that it is possible to construct a pavement whose surface is sufficiently rigid to resist the shearing effects created by vehicles with metal treads and to bear heavy loads dumped or stored thereon and which is, at the same time, sufficiently flexible to accommodate itself to deformation in the surface on which it is laid without incurring fissures or breaks. Furthermore, our new pavement is not only impervious to water but it also exhibits a resistance to oils and solvents, and it is able to withstand the effects of heat such as are encountered on runways for jet aircraft, for instance. Our

pavement can be laid as a continuous sheet free from joints and is easy to maintain since repairs can be effected therein in much the same fashion as has been practiced in the past in connection with pavements of the bituminous type. Furthermore, the surface of our pavement may be roughened so as to provide a non-skid road, for instance, and it may be colored as desired.

A semi-rigid pavement embodying our invention has a layer of natural aggregate containing pebbles which are bound together, with interstices between them, by a bituminous coating. Interstices between natural aggregates are occupied by artificial aggregate which contains hydraulic cement and polymerized resin. Such a pavement is made by spreading over the area to be paved a layer including an admixture of a natural aggregate containing pebbles and a bituminous binder therefor, graded in such a way that it has interstices therein. There is applied to the upper surface of that layer so that it penetrates the interstices in at least the upper portion of said layer, a grout containing hydraulic cement and resin adapted to set at ambient temperatures. In the practice of our invention, certain cold-polymerisable resins such as urea formaldehyde, included or not in the formulation hereinafter set forth, may be employed.

A pavement embodying our invention is illustrated schematically in the accompanying drawing which is a fragmentary vertical section thereof on an enlarged scale. The pavement shown includes pebbles 1 and a bituminous binder 2 coating said pebbles. The interstices between the coated pebbles 1 are occupied by artificial aggregate 3 containing hydraulic cement and polymerised resin. These pieces of artificial aggregate 3 may include, in addition to the cement and resin, an inert filler and, if desired, coloring material.

The pebbles 1 which constitute the natural aggregate in our new pavement, are of such size, shape and grading that the interstices between coated aggregates in the layer therof have diameters ranging from about 1 to about 5 mm. For that purpose, the pebbles of medium size (bigger than 1/7 of the maximum caliber and smaller than 1/3 of it) should represent 35% with a possible variation of + or −5%; the fine particles of less than 1/7 of the maximum caliber should represent only 15%, with a possible variation of + or −2%. After a layer of such a natural aggregate, with its bituminous binder, is spread on the ground it is lightly compacted so that in general the interstices occupy about 15% of that layer. To incorporate the artificial aggregate 3 therein, a grout is applied to the upper surface of the bituminous binder-natural aggregate layer. Such grout contains water, hydraulic cement and resin adapted to set at ambient temperatures; and may also include inert calcareous or silicic filler, and, if desired, coloring matter. It can be caused to penetrate the bituminous binder-natural aggregate layer by means of sweepers or "broom drags." Thereafter, the layer is compacted, as by means of a heavy roller, and the surface may be treated to smooth it as desired. Also, the impermeability of the surface may be augmented by applying thereto, in powdered form, one or more of the resins contained in the grout.

The resins that we employ in the practice of our invention constitute a most important component of the artificial aggregate 3 which occupies the interstices in at least the upper portion of our new pavement, for that artificial aggregate possesses a resistance to deformation comparable to that of hydraulic cement. The polymerization of the resin in the grout at the same time that the hydraulic cement is setting, provides a reticulated structure that is free from the micro-fissures that occur in hydraulic cement in the absence of resin. Therefore, our new pavement combines the advantages of flexibility and

rigidity in an impermeable surface covering since the pebbles **1** comprising the natural aggregate and the pieces of artificial aggregate **3** are bound to one another by the bituminous film **2** which provides a plastic bond between the convex surfaces of the natural aggregate and the concave surfaces of the artificial aggregate. The resins that are incorporated in the grout may be emulsified or not and, while natural or synthetic resins may be used, we prefer to use vinyl resins. A polymerized polyvinyl resin may be emulsified in very thin particles with the help of tensio-active emulsifying agents whose purpose is to stabilize the emulsion but not to prevent its setting at ambient temperatures by purely physical agglutination when the water content in the grout diminishes as a result of the hydration of the cement.

An illustrative formulation of a grout that is well adapted for use in the practice of our invention is as follows:

	Parts
Hydraulic cement	60
Inert calcareous or silicic filler	40
Water	70
Polyvinyl acetate	5
Urea formaldehyde	5
Ammonium chloride	0.5

The grading of the filler should be continuous so that the percentage of voids in the synthetic aggregate may be reduced.

The bituminous binder for the pebbles **1** may vary in composition according to the use for which the pavement in which it is incorporated is designed. For instance, in the construction of a takeoff strip at an airport good results can be obtained with 180/200 asphalt. However, in the case of a surface designed to bear heavy loads or the shearing action of metal treads, we prefer 80/100 asphalt. Also, the quantity of grout employed in the construction of a pavement embodying our invention will vary somewhat according to the end use of such pavement. On the average, however, we find that good results can be obtained through the application of 4–5 liters of grout per square meter of surface area.

The terms that have been used herein are terms of description and not of limitation and it will be appreciated that various modifications may be made in the specific embodiment that we have described without departing from the spirit of our invention as it is defined in the appended claims.

What we claim is:

1. A semi-rigid pavement comprising a layer of a natural aggregate containing pebbles, a bituminous coating binding said pebbles together so that there are interstices in said layer, and an artificial aggregate comprised of hydraulic cement and polymerized polyvinyl acetate and urea formaldehyde resin occupying the interstices in at least the upper part of said layer.

2. The method of making a semi-rigid pavement which comprises spreading over the area to be paved a layer comprising an admixture of an aggregate containing pebbles and a bituminous binder therefor, said layer having interstices therein with diameters ranging from about 1 to about 5 mm., and then applying to the upper surface of said layer, so that it penetrates interstices in said layer, a grout containing water, hydraulic cement and resin selected from the group consisting of urea formaldehyde and polyvinyl acetate adapted to set at ambient temperatures whereby an artificial aggregate is formed in and occupies said interstices.

3. The method of making a semi-rigid pavement which comprises spreading over the area to be paved a layer having interstices therein and comprising an admixture of an aggregate containing pebbles and a bituminous binder therefor, compacting said layer so that said interstices occupy about 15% thereof, and then applying to the upper surface of said layer, so that it penetrates interstices in said layer, a grout containing water, hydraulic cement and resin selected from the group consisting of urea formaldehyde and polyvinyl acetate adapted to set at ambient temperatures whereby an artificial aggregate is formed in and occupies said interstices.

4. The method of making a semi-rigid pavement which comprises spreading over the area to be paved a layer having interstices therein and comprising an admixture of an aggregate containing pebbles and a bituminous binder therefor, and then applying to the upper surface of said layer, so that it penetrates interstices in said layer, a grout containing about 60 parts of hydraulic cement, 40 parts of inert filler, 70 parts of water, 5 parts of polyvinyl acetate, 5 parts of urea formaldehyde and 0.5 parts of ammonium chloride.

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