Title: SPACER AND METHOD FOR LAYING PAVER

Abstract: The present invention relates to a spacer for a paver and to a method of using said spacer in the laying of such a paver.
SPACER AND METHOD FOR LAYING PAVER

The present invention relates to an improved paver and to a method of laying such a paver.

The paver of the present invention preferably is made of a natural stone, but could also be made of an artificial stone (generally a finely divided natural stone in a binding matrix) or stone substitutes such as pulverised glass in a binding matrix, or concrete. Used herein, the term "paver" includes paving components of any size (e.g. setts, slabs).

Any discussion of the prior art throughout the specification is not an admission that such prior art is widely known or forms part of the common general knowledge in the field.

Typically, a paved area is laid by providing a suitable bedding surface and then laying the pavers on the bedding surface in whatever pattern has been selected. The pavers are laid spaced slightly apart, a typical gap between each paver and the next being in the range 3 to 8 mm. When all the pavers have been laid, the gaps between adjacent pavers are filled with a specified grade of joint sand, or with mortar.

The bedding surface may be a flexible bedding surface (typically a sand/aggregate mixture) or may be a rigid bedding surface (typically mortar) depending upon the level of traffic on the paved area.

If the pavers are laid too close together, the joint sand cannot penetrate the joint properly and damage to the pavers can result if they then impact on each other when the paved area is subjected to its normal loads. Conversely, if the pavers are laid too far apart, the resulting paved area is weakened and will not perform adequately in use.

An object of the present invention is the provision of a paver, and a method of laying a paver, which overcome at least some of the above described drawbacks.

The present invention provides a spacer for use with a paver, such that said spacer is configured, alone or in combination with one or more additional spacers, to provide a predetermined spacing between two or more adjacent pavers and wherein, when in
use with said pavers, the spacer has restricted vertical movement relative to at least one of the adjacent pavers.

As used herein, the term "side of the paver" means the portions of the paver which are substantially vertical when one surface of the paver is substantially horizontal.

In one preferred form at least one spacer is secured to at least one of the sides of the paver.

Whether more than one spacer is used on one side of the paver depends upon the length of the side.

In the simplest form, each spacer is a cuboid, one face of which is secured to the side of the paver. However, the spacers may also be produced in a number of more complex shapes, as hereinafter described, and further may be formed so that spacers on adjacent pavers interlock.

In one preferred form a first spacer on a first paver includes at least one projection and a second spacer on a second, adjacent, paver includes at least one hollow, such that at least one projection and at least one hollow are dimensioned such that in use they interlock.

In a further alternative preferred form two 'L' shaped spacers dimensioned to interlock are configured to provide the predetermined spacing between the adjacent pavers.

In a further alternative preferred embodiment the spacer is L-shaped with two arms, such that said spacer is configured to be used on a corner of one of the pavers, at least one arm of the spacer is dimensioned such that in use it provides the predetermined spacing between adjacent pavers.

The spacers may be made of any of a wide range of suitable materials, e.g. stone, concrete, plastics, metallic, rubber-like (including rubber and synthetic rubbers) or a range of synthetic materials, but preferably should not be made of easily compressible materials. If the pavers are laid on a rigid bedding, and the joints between the pavers are to be filled with a mortar, then it may be advantageous if the material used for the spacer can be dissolved once the pavers are correctly
positioned, so that mortar can have full penetration through the joint. Such a material might therefore be a natural-based material.

The spacers may be secured/attached to the pavers by any suitable means, e.g. adhesive.

In an alternative preferred form each spacer is not directly attached to at least one paver, instead said spacer includes at least one foot configured to be retained underneath at least one paver when said spacer is in use.

Preferably each spacer includes at least one arm, where the at least one arm includes at least one hollow pathway.

Preferably each said arm includes a least one hollow prism. In a preferred form there are a plurality of hollow prisms. In a further preferred form the cross section of the or each hollow prism is independently selected. In a further preferred form the arm is made up of a plurality of linked hollow prisms. In a further preferred form one or more of the hollow prisms is a different length.

Preferably the spacer includes at least two arms. In a further preferred form the spacer includes more than two arms.

In a preferred form the spacer is L-shaped in cross section.

In a further preferred form the spacer is cross-shaped in cross section.

In a preferred form, where there are two or more arms, at least one foot extends between, and is attached to, two adjacent arms.

The present invention further provides a method of laying pavers which consists of providing a suitable bedding surface, and laying on the bedding surface a plurality of pavers provided with spacers as described above, such that the width of each joint between a paver and an adjacent paver is determined by at least one spacer optionally secured to at least one of the said paver and said adjacent paver.

The number of spacers secured to each paver will depend upon the shape of the paver, but sufficient spacers must be provided such that, when the pavers are laid in
the selected pattern, each joint between one paver and an adjacent paver is provided with at least one spacer.

The present invention also provides an alternative method of laying pavers providing a suitable bedding surface, and laying on the bedding surface a plurality of spacers which include at least one foot, such that the width of each joint between a paver and an adjacent paver is determined by at least one spacer, said foot being secured in place by the paver and/or said adjacent paver.

By way of example only, preferred embodiments of the present invention are described in detail below with reference to the accompanying drawings, in which:

Figure 1 is an isometric view of a paver fitted with spacers in accordance with a first embodiment of the present invention;

Figure 2 is a diagrammatic plan view of a second embodiment of the present invention;

Figure 3 is a diagrammatic plan view of a third embodiment of the present invention;

Figure 4 is a diagrammatic plan view of a fourth embodiment of the present invention;

Figure 5 is a diagrammatic plan view of a fifth embodiment of the present invention;

Figure 6 is a diagrammatic plan view of a sixth embodiment of the present invention;

Figure 7 is a diagrammatic plan view of a seventh embodiment of the present invention;

Figure 8 is an isometric view of an 8th embodiment of the present invention;

Figure 9 is an isometric view of a 9th embodiment of the present invention;

Figure 10 is an isometric view of a 10th embodiment of the present invention; and

Figure 11 is a plan view of the 8th and 10th embodiment spacers in use.

Referring to Figure 1, in a first embodiment of the invention, a paver 10 is a cuboid slab having a top surface 11, a bottom surface 12, and sides 13, 14, 15, 16, of which only 15 and 16 are visible. In use, the paver is laid resting on a suitable bedding material, (e.g. sand or mortar), with the bottom 12 flat on the bedding and the upper surface 11 substantially horizontal. In this position, the sides 13, 14, 15, 16 are substantially vertical.

Spacers 17, 18 are attached (e.g. glued) to each of the sides 15 and 16. Each of the spacers is a small cuboid of a tough, impact resistant plastics material and is secured to the corresponding side of the paver with one face of the cuboid flat against the
corresponding side. As shown in figure 1, spacers 17 and 18 may be of different sizes.

Both of the spacers are shown adjacent the lower edge of the corresponding side, but in fact the position of the spacer on the side is not critical: it can be located at anywhere around the corresponding side. In the case of long sides such as the side 16, it may also be advantageous to use a second spacer 18a on the side, spaced from the first spacer 18, as shown in broken lines in Figure 1. Of course, more than two spacers per side can be used if necessary (e.g. 3, 4, 5, etc.).

In use, the pavers 10 are laid so that the width of the spacer on one paver governs the width of the joint between that paver and the adjacent paver. The pavers are arranged so that each spacer is in contact with the adjacent paver. The number of spacers required obviously depends upon the shape of the paver; for example, a cuboid paver requires spacers on at least two of the sides. If more spacers than the minimum number are provided, then the position of the spacers must be such that the blocks can be laid without adjacent spacers contacting each other, because this would give a joint of twice the required width.

Figure 2 shows a second embodiment in which each side 19, 20 of the pavers 21, 22 is provided with two spaced spacers 23, 24, 25, 26. When the pavers are correctly laid, the outer faces 27, 28 of the spacers 23 and 24 are in contact with the side 20 of the paver 22, and the outer faces 29, 30 of the spacers 25, 26 are in contact with the side 19 of the paver 21. It will be noted that the spacers 23, 24, 25, 26 are located on the side of the respective paver such that when the pavers are correctly laid, the spacers do not contact each other, but only contact the adjacent paver, i.e. the width of the spacer is the width of the joint.

Figure 3 shows a third embodiment of the invention, in which the spacers are designed to contact each other, and to interlock. This gives an additional safeguard against displacement of the pavers in service. In this embodiment, the width W. of each spacer 32, 33 is equal to half of the width of the intended joint between adjacent pavers. The spacers 32, 33 are generally cuboid in shape but the outer surface 34, 35 of each spacer is formed with a projecting ridge 36 and a corresponding groove 37; the grooves 37 are sized to receive the ridges 36 as a sliding fit.
The spacers 32, 33 are secured to the sides of pavers 38, 39 as described above, and when the pavers are laid, they are arranged so that the ridge 36 on spacer 32 fits inside the groove 37 on spacer 33, and the ridge 36 on spacer 33 fits inside the groove 37 on spacer 32, effectively locking the pavers together against movements in the directions of arrows A.

Obviously, when interlocking spacers are used they are secured to the pavers at the same position, so that they interlock when the pavers are laid.

Figure 4 shows a fourth embodiment which is a further design of interlocking spacer:- in this embodiment, the spacers 40, 41 have an external face 42, 43 which is formed in a series of rounded projections and hollows. The shapes of the projections and hollows on the surfaces 42, 43 are complimentary:- Figure 4 shows the pavers 45, 46 spaced apart, i.e. not in the position in which they will be laid, for clarity, but it will be appreciated that when the pavers are pushed together so that the spacers 40, 41 contact each other, the projections and hollows on the external faces of the spacers fit together and thus restrain relative movement of the pavers in the directions of arrows A, as for the Figure 3 embodiment. The combined width of the spacers 42, 43 is the desired width of the joint between the adjacent pavers 45, 46.

Figure 5 shows a fifth embodiment which is another embodiment of spacer, in which the spacer 50 is L-shaped in cross-section, with a first portion 51 forming the actual spacer between adjacent pavers, and a second portion 52 extending perpendicular to the portion 51 and extending over the adjacent side of the paver 53.

The shape of the spacer 50 makes it easy for unskilled labour to locate the spacer correctly when fitting it, and also holds the spacer correctly in position during use.

Figure 6 shows a sixth embodiment which is another design of interlocking spacer:- the spacer 60 consists of two parts, 61, 62 (which are shown spaced apart in the interest of clarity) each of which is rectangular in plan with an L-shaped cutout 63, 64. The cutouts 63, 64 are identical in size but mirror imaged so that when the two parts 61, 62 are pushed together, the cutouts engage to both space the pavers apart and to prevent movement of the pavers in the directions of arrows A. The faces 61a, 62a, of the spacer are secured to the pavers.
Figure 7 shows a seventh embodiment which is a further design of corner mounted spacer 70, which provides two portions, 71, 72, the planes of which are mutually perpendicular, to form both a corner protector and a spacer:- the corner of the paver is fitted into the angle between the portions 71 and 72. A third portion 73 optionally is secured across the ends of the portions 71 and 72, so that when the spacer 70 is fitted in position over the corner of a paver, the portion 73 extends across one face of the paver, and so helps to space apart adjacent pavers in transit, and prevent damage to the face. Portion 73 is shown as a bar, but may be a plate, extending over the whole of the corner, to give added protection. The presence of the portion 73 also makes the spacer particularly easy to fit correctly onto the paver, and thus is especially suited to automated installation or installation by unskilled labour.

Figure 8 shows an eighth embodiment which is a further design of spacer 80 which includes a plurality of hollow prisms 81, 82 each attached to an adjacent hollow prism 81,82 along a coterminous side 83. A hollow prism 81,82 can be attached to more than one adjacent hollow prism 81,82 by different coterminous sides 83. For clarity, and as used herein, a hollow prism 81,82 is a solid geometric figure whose two end faces 84 are similar, equal, and parallel rectilinear figures, and whose sides 83,85 are parallelograms which includes a hollow pathway 86 between said end faces 84.

In general the hollow pathway 86 will be concentric with the prism 81, but it can have any cross sectional shape (circular, triangular, rectangular, pentagonal, hexagonal, septagonal, octagonal etc). The hollow pathway 86 is present to allow the spacer 80, when in use, to provide a flow path for water or other fluids. Each said hollow prism 81 may have the same cross-sectional shape, but this is not essential or necessarily desireable.

For the eighth embodiment the spacer 80 is cross shaped, with each arm 87 consisting of a plurality of hollow prisms 81 with a regular hexagonal cross section. In this form two opposite vertices 88 of each hollow prism 81 forming the arms 87 are exposed. A central hollow prism 82, with a regular octagonal cross section, forms the central point of the spacer 80 and each arm 87 is attached to, and extends away from said central hollow prism 82. Each arm 87, in this embodiment, is at right angles to the adjacent arms 87. The spacer 80 optionally further includes a foot 89 joining each arm 87 to an adjacent arm 87, each foot 89 optionally is a strip of material attached to the end face 84 of a hollow prism 81 in each of two adjacent arms 87. Each foot 89 lies on the same plane. It should be noted that even though this embodiment has arms 87 of the same length, different length arms 87 are also
envisioned. Optionally, there may be a number of feet connecting each arm to one or more of its adjacent arms (as shown e.g. in Figure 10).

Figure 9 shows a ninth embodiment which is a further design of the eighth embodiment but in this case the spacer 90 is 'L' shaped in plan view, and includes only two arms 87 at right angles to each other. In this embodiment each arm 87 optionally includes one or more second foot 91. Each second foot 91 is a flat plate attached to the end face 84 of one or more hollow prisms 81, each second foot 91 lies planar with the plane formed by the end faces 84. At least one foot 91 optionally may extend either side of each arm 87.

Figure 10 shows a tenth embodiment which is a still further variation of the ninth embodiment, in this case the spacer 100 is a single arm 87 of hollow prisms optionally with at least one second foot 91.

Figure 11 shows one way of using the spacers 80, 100 of the eighth and tenth embodiments in use with two adjacent pavers 110,1 11. In this case the arm 87 of spacer 100 of the tenth embodiment lies between, and parallel to, the two closest sides 112,1 13 of the adjacent pavers 110,1 11, each second foot 91 lying underneath one of the pavers 110,1 11.

One arm 87 of spacer 80 of the eighth embodiment lies between, and is parallel to the two closest sides 112,1 13 of the adjacent pavers 110,1 11, the two adjacent arms 87 each lie against a further side of the respective adjacent paver 110,1 11. One foot 89 of the spacer 80 of the eighth embodiment lies under each of the adjacent 110,1 11 pavers.

The distance between adjacent pavers 110,1 11 is determined by the linear distance between the exposed vertices 88 on opposite sides of each hollow prism 81. When in place the hollow prisms 81 of each spacer provide a flow path between adjacent pavers 110,1 11 which provides drainage and/or a void for the grout or jointing material.

Embodiments which include arms may well have arms that are not at right angles, or any other multiple of 90 degrees, for example if hexagonal or other shaped pavers/tiles need to be laid arms at 60 degrees may be needed.
In a further embodiment of the invention, the spacer is made of a material which is flexible, such that it can be provided on irregularly-shaped pavers/tiles. Alternatively, or in addition, the spacer may comprise segments attached/linked to other segments of the spacer in a moveable manner such that the spacer can be manipulated to conform to various required angles of paver/tile joints.

It should be noted that although described as a plurality of interconnected hollow prisms 81 the spacer may in fact just include a plurality of hollow pathways 86 and otherwise be similar to any of the other described embodiments. The spacer of this form could be interconnecting, include at least one foot or be permanently or releasably attached to a side of a paver. It should be noted that these spacers are not necessarily formed as part of the initial manufacturing process of forming the paver they are separate items attached to or used with the paver.

It should be noted that in some embodiments (not shown), where the spacer 80,90,100 includes hollow prisms 81,82, the side 85 can provide the contact between the spacer 80,90,100 and the adjacent paver 110,111, rather than the vertices 88.

It should also be noted that the spacers 80,90,100 that consist of hollow prisms 81,82 are described as including at least one foot 89,91, this is not necessary, and instead spacers 80,90,100 of this form could be directly secured to the pavers before or during assembly.

In some embodiments, the spacers may comprise one or more protrusions which fit into corresponding one or more cavities in the paver/tile such that the spacer is secured to the paver/tile in this manner. Optionally, the spacer may then be further secured to the paver/tile by e.g. adhesive, or other bonding. Such a configuration may provide additional strength to the attachment of the spacer to the paver, such that it is less likely to be knocked out of place by e.g. accidental contact.

As will be apparent to those skilled in the art each of the hollow prisms 81,82 can have any cross sectional shape and still perform the same role. For example the hollow prism 81,82 may have a cross sectional shape which has 3,4,5,6,7,8,9,10,11 or more sides, and may be a regular or irregular polygon. It should also be noted that star shaped cross sections with 3,4,5,6,7,8,9 or more points are also envisioned.
Though embodiments 8 to 10 of the spacer 80,90,100 show the hollow prisms 81,82 being an interconnected chain of similar height there may be sections of the spacer that are not hollow prisms 81,82 or of differing height.

Though embodiments 8 to 10 describe the relevant spacer 80,90,100 as having at least one foot 89,91 it is envisioned that the spacer 80,90,100 may well be constructed without a foot 89,81 and used similarly to earlier spacers.

In certain configurations, where the spacer is one of embodiment 8 to 10 the jointing compound may be forced through the gaps between the sides of the spacer and the sides of the paver. This jointing compound acts to secure the spacer to the paver when in use.

It will be appreciated that different types of spacer may be used on a single paver.

It should be noted that all of the above described spacers could also be used to prevent against damage to the pavers caused by "stone rub", i.e. the damage caused by adjacent faces of the pavers rubbing together during packing and transit.

While the spacer has been described above with reference to various 'embodiments', it will be appreciated that the features described in each of the 'embodiments' are optionally interchangeable with other features described in relation to other 'embodiments'.

If the pavers are laid on a flexible bedding, (e.g. sand or sand/aggregate) then it is desirable that the spacers remain attached to the pavers permanently. However, if the pavers are laid on a rigid bedding, (e.g. mortar) then it is preferable that all of the joints between the pavers are filled with mortar. Thus, it is desirable that, once the pavers have been correctly laid, with the joints maintained at the correct width using the spacers, that the spacers can then be dissolved or otherwise removed so that the entire area of the joints can be filled with mortar. This may be achieved by using a material for the spacers which is degradable and can be dissolved either by mixing a dissolving substance with the mortar or by using a prewash which includes a dissolver; the prewash is washed over the pavers before the mortar is applied to the joints.
If it is necessary for a paver to be cut to size the time of laying, and this results in the removal of a spacer, a separate spacer can be placed into that joint, to achieve the correct spacing of the joint.

As described above, it is considered that the spacers will assist in achieving the correct gap between adjacent pavers, and in maintaining this at the correct width in service, if permanent spacers are used. Additionally, it is envisaged that the use of spacers in accordance with the present invention will greatly assists in the mechanised laying of pavers, since the pavers equipped with spacers can be laid rapidly without relying on the skill of the operator.

Another way to restrain unwanted movement of the pavers in service is to texture the bottom and/or sides of each paver, to improve the adhesion between the bottom of the paver and the bedding material, and between the sides of the paver and the joint material, as the case may be.

The degree of texturing used can be selected to suit particular requirements and maybe anything from deep grooving or texturing with a hammer to give a "lychee" finish to a light surface roughening e.g. exfoliation caused by heating the surface with a gas torch to cause surface spalling.

In some embodiments of the present invention, there is provided a method of laying a plurality of pavers comprising providing a first paver with a spacer of the present invention and laying said first paver on a bedding material, placing a second paver adjacent the first paver, said second paver optionally comprising a spacer of the present invention, and providing a blend in the ensuing gap between said pavers.

Preferably, the blend provided between the gaps comprises an organic binder and crushed glass.

In the modular paving industry, it is important to select the type of construction technique appropriate to the situation. Generally there are two categories of construction, bound or unbound. Bound construction means paving elements bedded and jointed using rigid mortar or plastic and/or ductile bound aggregates. The term "plastic" in this context refers to the mode of behaviour under stress. Unbound aggregate means paving elements bedded and jointed using only aggregate.
In particular, the present invention relates to blends comprising a water absorbent organic binder in combination with an aggregate material.

Modular paving may be constructed using unbound aggregates for both bedding and jointing. Within limits the unbound aggregate bedding and jointing media may deform in response to applied forces and subsequently reform in a slightly different position, from the action of gravity, vibration and water movement through the matrix of unbound aggregate particles. The inventors note that this traditional system of construction is highly desirable but has limits beyond which its use is practical in heavily trafficked and urban situations.

Systems of binding the aggregate particles which comprise bedding and jointing for modular paving such that the bound medium is thus flexible and plastic and/or ductile have previously been developed by others. These products typically employ polymeric resins and similar man-made chemicals. The present inventors have identified that these materials deform relatively easily in compression, due to thermal stress or applied forces, but are unable to return to their original form after a period of fatigue loading. This process leads to failure relatively early in the service life of a pavement.

The growing use of polymeric resin binders in various bound aggregate blends is not ideal, since the manufacture of these polymers is often not without adverse environmental and cost implications. Thus, the present inventors advantageously use organic binders in the manufacture of the present inventive bound aggregate products. Moreover, the present inventors have noted that the commercial recycling of glass is an industry in its infancy, and whilst stockpiles are large, good uses to date are limited. The present inventors have surprisingly found that the inclusion of crushed glass into bound aggregate blends comprising an organic binder component results in a product that has advantageous properties over the current commonly used bound aggregate products, which employ only aggregates such as sand or grit.

In particular, the present inventors have found that recycled glass performs particularly well under test conditions, when combined with a plant-based binder.

Thus, in one embodiment of the present invention there is provided the use of a binder blend comprising an organic binder component and a glass component.
Preferably each of the binder component and glass component is present as a particulate material, such as a powder.

Preferably, the organic binder component comprises a plant-based binder. The binder component is preferably 'activated' when it comes into contact with a liquid, and is preferably water-activated. By "water-activated" it is meant that the binder component changes properties when it comes into contact with water such that, in the present case, a glue-like substance is formed from the binder component as it interacts with water. Such a substance is sometimes referred to as mucilage. Such an adhesive property is advantageous as it aids in binding the glass component and optional other ingredients together.

Such an activation of the binder component is mediated at least in part by the amount the binder component swells on activation with water. The binder component preferably has a swell volume of at least about 10 ml/g, preferably at least about 20 ml/g. Preferably, the binder component has a swell volume of less than about 100 ml/g. More preferably, the binder component has a swell volume in the range of between about 15 ml/g and about 80 ml/g. Yet more preferably, the binder component has a swell volume in the range of between about 20 ml/g and about 70, 60 or 50 ml/g, preferably in the range of between about 30 ml/g to about 50 ml/g. Yet more preferably, the binder component has a swell volume in the range of about 20 ml/g to about 30 ml/g, preferably about 25 ml/g to about 45 ml/g, preferably between about 27 ml/g and 42 ml/g. In some embodiments the swell volume is between about 30 ml/g and 40 ml/g. In some embodiments, the swell volume of the binder component is around 35 ml/g.

In preferred embodiments of the present invention, the binder component is derived from the plant genus Plantago. Preferably, the binder component is derived from Plantago ovata, or psyllium, and preferably derived from its seeds or husk. More preferably, the plant binder is a psyllium-derived powder, such as psyllium husk powder or kha kha powder, which is a byproduct of psyllium husk production. Such psyllium powder is commercially available from a variety of suppliers (such as from JYOT OVERSEAS PVT LTD, Gujarat, India).

Alternatively, or in addition, the binder component may be derived from other plant families, such as the cereals or pines, as long as the derived products are able to
swell when in contact with water to produce an adhesive (e.g. mucilage). Such a plant product may be derived from e.g. oats, barley, rice, wheat, millet, maize, etc.

The binding property of psyllium and other similar organic binders is believed to be due to the content of special proteins and polysaccharides on the one hand and on the other hand an apparent high content of natural silicic acids. Proteins and polysaccharides are able to absorb water, subsequently to swell to a high degree and to form a kind of natural glue. Silicic acids can work as a chemical bridge (forming -O-Si-O- bonds) between the organic components of psyllium (proteins and polysaccharides) and the inorganic components of the aggregate (silica or quartz sand, crushed granite or similar stones), since the chemical structure of silicic acid is similar to that of the stone.

Psyllium is interesting for pavement jointing and pathway surfaces because it is reactivated whenever moisture is introduced, whereupon it can swell into adjacent spaces, close gaps and help to hold the matrix of aggregate particles in a cohesive mass using its adhesive qualities.

The organic binder component of the present invention may comprise impurities as well as the active ingredient of interest. Such impurities may comprise such things as light and/or heavy extraneous material (such as dust, agro farm fibres, wastes, mud, gravel and iron particles including organic fibres such as Psyllium Industrial Dust) ash, acid insoluble ash, etc. Generally these impurities will have come from the various processing steps used to create the final organic binder powder, or may be a result of the growing and harvesting conditions of the organic binder. Generally, the purity of the organic binder component will be greater than about 70 %, preferably greater than about 80 %, preferably greater than about 85 %, with the remaining % being made up of one or more impurities. In some embodiments, the purity of the organic binder component may be at least 90 %, 95 %, 96 %, 97 %, 98 %, 99 % or about 100 %.

A problem with previous applications has been combining the need to supply moisture to the mortar matrix with the need to create a more or less compact matrix. In previous applications this required a stone with a higher than usual proportion of very fine particles, the fine particles acting rather like a sponge to hold moisture. This runs counter to the fundamental requirements of unbound pavement jointing technology and such a material used for jointing would be easily displaced or
squeezed out when paving elements move under traffic loads. The rock types which produce such a high proportion of fine particles are often referred to as "rotten rock" and not only produce a very high fines content when crushed but have a relatively high water absorption.

Thus, in the present invention, in combination with the organic binder component of the present inventive blend, there is also the presence of crushed glass forming a particulate component. In preferred embodiments, the glass is recycled glass.

In particular embodiments, the particles of recycled glass have been processed such that the majority of the particles exhibit substantially rounded edges. Such a shape is believed to be advantageous as it allows optimal voidage for water percolation when used in combination with other materials such as aggregate or sand and provides both optimum shape and surface texture for the organic binder to function effectively.

Thus, in further preferred embodiments, the crushed glass has been produced using a high velocity impact, preferably autogenous crushing process. An autogenous crushing process is one where the glass particles are used to crush themselves. Preferably such a process occurs during the use of a so-called "Vertical Shaft Impact" (VSI) crusher, such as employed in certain Barmac crushers.

Thus, the recycled glass used may be initially processed into a glass cullet by an impact crusher, such as a hammer mill. The type of crusher used at this stage is not important. Typically, the next stage in the process is that the glass cullet is washed and dried, in order to remove the majority or substantially all organic and inorganic contaminants, such as sugar, paper, metal and plastics. The washed and dried glass cullet is then further processed to produce particles in sizes varying from 2mm down to 1micron depending on the requirements of the end user in a high speed attrition rotary crushe with the primary objective of 'rounding' the sharp edges of the each individual particle to produce recycled glass particles that are defined as sub-angular cuboid in shape.

In some embodiments of the present invention, the crushed glass is present in the basic binder blend with the majority of the particles being greater than about 50 μm in approximate diameter. In some embodiments, the majority of the glass particle size in the binder blend is preferably less than about 1 mm in approximate diameter. Preferably, the majority or substantially all of the particle size distribution is between
about 50 µm to about 1000 µm. More preferably, the majority or substantially all of the particle size distribution is between about 50 µm to about 800 µm. More preferably, the majority or substantially all of the particle size distribution is between about 80 µm to about 600 µm. Yet more preferably, the majority or substantially all of the particle size distribution is between about 200 µm to about 800 µm, or about 200 µm to about 600 µm.

Such particle size distributions are achievable using standard techniques, for example by crushing and sieving through appropriately sized sieves or meshes.

Crushed glass obtained from commercial suppliers (such as Green Future Recycling Ltd, Lancashire) can be reasonably accurately graded and purchased according to need. Further laboratory testing can be conducted to confirm particle size range if required.

Glass is not just "another aggregate". All natural stone aggregates have a degree of water absorption, some more than others. Glass effectively has none yet it is hydrophilic, i.e. it attracts water but does not absorb it. In addition glass is well known for the capillary effect it has with water.

Introducing crushed glass into the aggregate blend and omitting the high proportion of very fine aggregate particles produces a particle size distribution (PSD) similar to that normally required for jointing material used in documented unbound construction methodology. It is no longer necessary to employ "rotten rock" and stronger, more suitable stone types may be used. The joint is more water permeable when using crushed glass to replace the otherwise high fines content and so the organic binder of the present invention can be supplied with moisture more quickly and at a more even rate through the depth of the joint in modular paving or the depth of a pathway surfaced using this product.

Using crushed glass as the conduit to supply moisture to the organic binder enables the use of optimal particle size distribution of crushed rock or sand, thus creating a structurally sound jointing product rather than the weaker, decorative use of materials which do not include crushed glass and which therefore employ a high proportion of fine aggregate particles.

Referring to the use of this invention for pathway surfacing rather than for jointing materials, the same use of crushed glass to replace the otherwise excessive fine
particle content of the finished product is also relevant. By introducing crushed glass and omitting the very high proportion of fine aggregate particles otherwise needed, the finished pathway is more water permeable in service and the organic binder (e.g. psyllium) can be supplied with moisture more quickly and at a more even rate through the depth of the structure.

In further embodiments of the present invention, the binder blend preferably comprises the plant binder component in a range of up to about 15% by dry weight of binder + glass and the glass component in a range of at least about 85% by dry weight of binder + glass. More preferably, the plant binder component is present in a range of about 1% to about 10% by dry weight of binder + glass with the glass component being present in a range of between about 99% and about 90% by dry weight of binder + glass. Yet more preferably, the plant binder component is present in a range of between about 2% and about 7.5% by dry weight of binder + glass with the glass component being present in a range of between about 98% and about 92.5% by dry weight of binder + glass. Yet more preferably, the plant binder component is present in a range of between about 2.5% and about 6% by dry weight of binder + glass and the glass component is present in a range of between about 97.5% and about 94% by dry weight of binder + glass. Yet more preferably, the plant binder component is present at around 5% by dry weight of binder + glass and the glass component is present at around 95% by dry weight of binder + glass. If glass or aggregate was not actually kiln dried, the typical moisture content might be circa 2%-5% and this would not significantly affect the quantities.

In the above ranges, the combined totals of the plant and glass components necessarily equate to 100% of the binder component + glass component weight.

The basic blend may include a variety of other components, such as recycled plastics within the aggregates or geosynthetic aggregates and/or recycled rubber fines which may aid flexibility. In situations where a modular pavement having joints filled with this product might encounter very high volumes of surface water and/or high pressure water cleaning methods are employed, it can be advantageous to include "rubber crumb" granules, e.g. from recycled vehicle tyres, within the product recipe. By rubber crumb, it is to be understood that any rubber-like material may be suitable, such as synthetic rubber and synthetic rubber blends. The size of the rubber crumb used is typically 0-1 mm (e.g. 0.2, 0.3, 0.4, 0.5, etc.) although in some situations larger sizes may be usefully employed (e.g. approx. 1, 2, 3, 4, 5 mm). Rubber crumb
typically may be added in proportions not more than about 10% by weight of the overall product dry mass by weight (i.e. binder blend + aggregates). More typically rubber crumb is added in the proportion 5% by weight of the overall dry product mass, although other proportions may be about 1-5 % by weight, 1-10% by weight, 2, 3, 4 % by weight.

The effect is that the exposed surface of the material is noticeably hydrophobic whilst water permeability is not reduced and the crushed glass remains effective in actively transferring water to the psyllium. Abrasion resistance of the surface during periods of very heavy wetting is enhanced by this addition of rubber crumb.

Preferably, the basic blend does not include fibre strands. In some embodiments of the present invention, and as discussed above, there may be nominal amounts of impurities present in the binder blend. Such impurities might comprise, e.g. light and/or heavy extraneous matter (as discussed above), ash, acid insoluble ash, ultra-fine crushed glass particles etc. The total amount of impurities and/or other components in the blend may equate to approximately 0.1 % - 20 % of the weight of binder + glass components, optionally about 5 % to about 15 %, optionally about 1 % to about 10 %, optionally about 0.1 to about 1 %.

In some embodiments of the present invention, the blend does not include non-plant based binders, such as artificial polymers. In alternative embodiments of the present invention, there may be one or more additional polymers (natural or artificial) present in the blend or final mixture (i.e. blend + aggregates). For example, for joint filling material in urban locations where aggressive cleaning regimes are used, abrasion resistance at the surface of the joints between paving elements filled with this material may be enhanced by the addition of a small quantity of a water permeable polymer, such as Elotex FX2322 or another similar polymer (e.g. DOW DLP 2001). The effect of adding this polymer is very different from those effects sought by applications for straightforward "polymer sand" products. Products which comprise only sand, water soluble polymer and perhaps some other soluble or insoluble minerals rely for their stiffness on the polymer, it being the sole significant binding agent. Such patents invariably specify a relatively large amount of polymer to be added.
The present invention preferably relies upon the swelling effect of the organic binder (e.g. psyllium) to provide stiffness and, to a substantial extent, the adhesive properties of psyllium to binds the matrix together.

The addition of a small amount of water soluble polymer, typically less than about 3% and more typically either about 1% or 2% of the overall dry product mass by weight (i.e. binder blend + aggregates), provides a tensile connection between aggregate particles which the swelling psyllium can push against (e.g., in a similar way to blowing up a football or rather a lot of footballs in an enclosed net). The same amount of polymer added without any organic binder (e.g. psyllium) produces a relatively weak and soft matrix using the same proportions of aggregate and glass or aggregate alone. It is the combination of psyllium and water soluble polymer which provides enhanced stiffness and resistance to abrasion at the surface of the joints.

There is an additional synergy between a water soluble polymer and organic binder (e.g. psyllium) which is relevant to the installation phase of filling the joints in a modular pavement. In this regard, a water soluble polymer is activated by water but the "curing" of the polymer, where cross bonding takes place, requires that water is subsequently lost from the system. Other applications have employed Portland cement or hydraulic lime as desiccants to effect this dehydration of the matrix. In the present invention, the organic binder (e.g. psyllium) acts as a desiccant within the freshly mixed product. As the binder absorbs water from the freshly mixed and applied product it proceeds to swell concurrently with the polymer curing, this combined effect is beneficial to both constituents and the product as a whole.

The binder component and the crushed glass component of the inventive basic blend (with or without impurities or other components) can be mixed together in the appropriate ratios under dry conditions prior to use. In such an embodiment, the blend may be packaged as a pre-mixed composition, awaiting the addition of water and optionally other aggregates to form a finished product.

Optionally, the binder component and the crushed glass component may form a kit of parts, each part packaged separately from the other. In this case, a user would be required to mix appropriate proportions of binder and glass powder together before or during the addition of water in order to create the final blend. The kit of parts may include instructions as to the various ratios to be combined. The kit of parts much also comprise additional implements such as a measuring scoop for ease of use.
It is intended that the product is mixed with water, into a flowable slurry, prior to installation and applied without delay after mixing to fill the joints.

When the product is to be used as a homogenous surfacing material it is usual to add a relatively small amount of water and the product thoroughly mixed to a consistency generally referred to in the industry as "soil moist", that is to say that when a quantity of material is grasped in the hand and the grip released, the material forms a cohesive mass which does not crumble.

When the product is to be used as a joint filling material for modular pavements, as an alternative to being mixed and applied in the "soil moist" form, it is possible to mix extra water so as to form a wet, free-flowing slurry which is allowed to slump into the open joints.

In use, therefore, water is added to the mixture of plant binder and glass powder. The amount of water added will be readily known to the skilled person, but will typically be in the region of approx. 100 - 175 litres water per tonne of gross product depending on aggregate moisture content. Typically, the water will activate the binder component on contact, with the binder component swelling as it absorbs the water. As the blend is mixed with the water, an aggregate paste is formed between the swollen binder particles and the glass particles, which, after drying, forms a resistant structure useful for a variety of construction needs. Due to the relatively high hydraulic conductivity value, the glass readily binds with the mucilage, making a nano-composite within the overall aggregate composition which decreases the magnitude of stress when the water content is increased.

The basic blend should remain in a cohesive mass which requires a physical force to be applied in order to disrupt the matrix.

Thus, in some embodiments of the present invention, there is provided the basic inventive blend as described above (i.e. comprising, or consisting essentially of, a portion of plant binder and a remaining portion of crushed glass (preferably recycled)). Such a blend is advantageous as it exhibits favourable properties without the need for commonly additional components such as fibres, which are often added to improve the binding properties of aggregate blends.
By using crushed recycled glass together with the organic binder described, the inventors have identified that this combination can universally be added to aggregate blends having a smaller concentration of very fine particles than is otherwise possible. The use of a high proportion of very fine particles in existing blends is often disadvantageous as the resulting blend prevents water from easily draining through the blend. The products of the present invention are preferably more water permeable than existing blends, which is desirable in both ecological terms and in the mechanical functionality of the materials in service.

Preferably, there is no or little Pozzolanic effect of the compositions of the present invention.

Thus, in some embodiments of the present invention, there is substantially no occurrence of ultra-fine particles (e.g. less than 50 μm) of glass. Optionally, less than about 10% of the glass particles used are less than 50 μm, preferably less than about 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2% and 1%. Such particles typically make up more substantial portions of existing mixes.

In this regard, in certain embodiments of the present invention, the glass preferably has gone through a process whereby a large proportion, and preferably the majority, of the ultra-fine particles have been removed. Such a process can be one such as a heating process, a vacuum process, or a washing process.

The inventors have identified a specific and unique advantage in this system which combines the best of both the unbound system and the plastic and/or ductile bound system. In common with the plastic bound systems which employ polymeric and resin binders, the present blend is considerably more stiff than an unbound aggregate matrix but will deform under stress. The advantage this organic binder system has is twofold; (i) when dry the material becomes more friable and is capable of subsequently reforming or settling in a way similar to an unbound system; (ii) when water is present the additional swell volume provided by the organic binder serves to actively stiffen the matrix once again. This constantly rejuvenating system results in a bound aggregate matrix which is flexible and plastic or ductile in behaviour, which continually self-heals in service and therefore has an enhanced lifespan.

The inventors have tested this combination of organic binder and crushed recycled glass together with a range of different courser aggregates, producing severally a
successful bound homogenous aggregate for pathway construction, a successful bound bedding aggregate and a successful bound jointing aggregate.

Thus, in alternative embodiments of the present invention, there is provided a 'finished' (aggregate) product comprising the basic inventive binder blend as described herein in combination with further components, such as other aggregates, which further components are bound together by the inventive basic blend.

As used herein, a 'finished', or aggregate, product is one that comprises the basic inventive blend in combination with larger components, typically one or more courser aggregates that come in a range of relatively larger particle sizes than those used in the binder blend, such as sizes ranging from e.g. about 1 mm to about 10 mm. Such courser aggregates can comprise sand (natural / dredged), which typically has particle sizes in the 1 mm range and downwards, grit (e.g. crushed rock fines), which typically comprise particle sizes in the 5 mm range and downwards; and even larger aggregates which may be present in particle sizes of 10 mm and downwards (such as CEDEC™). A 'finished' product as described herein does not necessarily curtail the use of the product with further components.

As used herein, aggregates present in a finished product may comprise many of the well known aggregates currently used in construction, and which come in a variety of different particulate size ranges. Such aggregates may typically comprise crushed natural stone, grit, course sand, fine sand etc. The sand may be naturally occurring or dredged.

Moreover, in some embodiments of the present invention the aggregate component used in the finished products may comprise or consist essentially of larger particles of crushed (preferably recycled) glass than the sizes of the glass particles used in the basic binder blend. In such finished products, the recycled glass content of the final product may therefore make up approximately 100 % by weight of the non-plant-based component of the total product (excluding any impurities present).

In some embodiments of the 'finished' products of the present invention, the binder blend preferably makes up to about 30 % of the total dry weight of the finished product, with the additional components (e.g. aggregates) making up the rest of the product (e.g. at least about 70 %). Preferably, the basic binder blend makes up between about 5 % and 25 % of the total dry weight. Yet more preferably, the binder
blend makes up between about 10% and about 20% of the total dry weight of the total dry weight. In some embodiments, the binder blend makes up about 20% of the finished product, with the additional components making about 80% of the finished product. In some embodiments, the binder blend makes up about 10% of the finished product, with the additional components making about 90% of the finished product.

Example 1 - Preparation of basic binder blend

A number of test samples were prepared.

These samples comprised between 2% and 7.5%, and typically 5% (by weight of dry basic blend) of psyllium husk powder (JYOT OVERSEAS PVT LTD, Gujarat, India) with a range of swell volume from 27 ml/g to 42 ml/g (average swell volume of 35 ml/g) as guaranteed by the supplier.

The remainder of the basic blend was made up of crushed recycled glass (such as Green Future Recycling Ltd, Lancashire) with an average particle size of about 80 \( \mu \text{m} \) to about 600 \( \mu \text{m} \).

Example 2 - Preparation of aggregate products

To the basic blends as described in Example 1, various course aggregates were added. Depending on the intended use of the aggregate product, the examples comprised aggregates containing sand at approximately 1 mm size particles and down, grit (natural crushed stone aggregate) with an aggregate particle size of 5 mm and down, and CEDEC™ (CED Ltd, Essex, UK) with an average particle size of crushed stone at 10 mm and down.

Additionally, test samples of aggregate products were prepared where crushed recycled glass was used as the additional component. This crushed recycled glass was courser than the particles used in the preparation of the basic blend, having an average particle size of between 1 mm and 10 mm.

In the preparation of the aggregate products, the basic blend was mixed with the course aggregate in a ratio of approx 20% basic blend to approx. 80% course aggregate for the sand and grit compositions, or approx. 10% basic blend to approx.
90% course aggregate on the CEDEC™ composition, depending on the intended use of the finished product. Products intended for use as bedding and jointing for modular paving employ an approx 20% basic blend to 80% course aggregate whereas products intended for use as homogenous layers employ 10% basic blend to 90% course aggregate.

Example 3 - Cohesiveness and friability testing

Each recipe was thoroughly blended together with excess water, such that a mix typically having a 50% slump was produced.

These blends were packed and levelled into a heat resistant open topped container, to a depth of between 40 and 70 mm.

Each container, with sample, was placed in a heated oven and dried at a temperature of circa 95°C for sufficient time for the water to evaporate. The time allowed for this was approximately 5 hours.

The desiccated sample was removed from the container and examined for cohesiveness and physical strength and stiffness.

The surface of the sample was abraded in order to assess the friability and short term wear resistance of the sample, this is achieved by approximately simulating footfall (a gloved finger is adequate for a laboratory test).

Example 4 - Environmental testing

The samples were placed back into their containers and water was added to fully cover the sample, such that became fully saturated. The time allowed for this was approximately 5 hours.

The surface of the samples were then abraded in order to assess the friability and short term wear resistance of the sample, this is achieved by approximately simulating footfall (a gloved finger is adequate for a laboratory test).
The repeated desiccation and soaking phases of this test cycle replicate the extremes of climate during the service life of a pavement constructed using this product.

Example 5 - Results I - comparison of basic blends

Comparison of the basic blend comprising 5% plant binder component and 95% crushed glass with standard mortars exhibited advantageous results over blends where no crushed glass powder was present.

Example 6 - Results II - comparison of aggregate products

Comparisons of aggregate blends which feature only natural stone aggregate or sand, against the same materials in combination with the inventive basic blend of the present invention in comprising crushed recycled glass prove that the samples containing crushed recycled glass are significantly superior to those comprising only natural stone aggregate with no crushed glass.

It appears that the crushed glass replaces what would otherwise need to be much finer particles of aggregate. Existing aggregates require a very high proportion of fine particles results in a more or less impermeable mass which is less quick to respond to changes in ambient moisture. By employing crushed recycled glass the present invention allows a wide range of aggregate to complete the finished products and these products are more water permeable in addition to being more resilient in service.
CLAIMS

1. A spacer for use with a paver, such that said spacer is configured, alone or in combination with one or more additional spacers, to provide a predetermined spacing between two or more adjacent pavers and wherein, when in use with said pavers, the spacer has restricted vertical movement relative to at least one of the adjacent pavers.

2. The spacer as claimed in claim 1 characterised in that least one spacer is secured to at least one of the sides of the paver.

3. The spacer as claimed in claim 1 or claim 2 characterised in that, each spacer is a cuboid, one face of which is secured to the side of the paver.

4. The spacer as claimed in any one of claims 1 to 3 characterised in that each spacer is formed so that spacers on adjacent pavers interlock.

5. The spacer as claimed in claim 4 characterised in that a first spacer on a first paver includes at least one projection and a second spacer on a second, adjacent, paver includes at least one hollow, such that at least one projection and at least one hollow are dimensioned such that in use they interlock.

6. The spacer as claimed in any preceding claim characterised in that the spacers have an 'L' shape cross section, such that said two said spacers are configured, in combination, to provide the predetermined spacing between the adjacent pavers.

7. The spacer as claimed in claim 1 or 2 characterised in that the spacer is L-shaped with two arms, such that said spacer is configured to be used on a corner of one of the pavers, at least one arm of the spacer is dimensioned such that in use it provides the predetermined spacing between adjacent pavers.

8. The spacer as claimed in any one of claims 1 to 7 characterised in that the or each spacer is secured to the pavers by any suitable means.

9. The spacer as claimed in claim 8 characterised in that the or each spacer is secured to the pavers by adhesive, optionally where one or more spacers has at least one protruding portion that protrudes into a corresponding cavity in the paver.
10. The spacer as claimed in any preceding claim characterised in that each spacer includes at least one foot configured to be retained underneath at least one paver when said spacer is in use.

11. The spacer as claimed in any preceding claim characterised in that each spacer includes at least one arm, where the at least one arm includes at least one hollow pathway.

12. The spacer as claimed in claim 11 characterised in that each said hollow pathway is part of a hollow prism.

13. The spacer as claimed in claim 12 characterised in that each said arm includes a plurality of hollow prisms.

14. The spacer as claimed in claim 12 or 13 characterised in that the arm is made up of a plurality of linked hollow prisms.

15. The spacer as claimed in any one of claims 12 to 14 characterised in that the cross section of the or each hollow prism is independently selected.

16. The spacer as claimed in any one of claims 13 to 15 characterised in that one or more of the hollow prisms is a different length.

17. The spacer as claimed in claimed in any preceding claim characterised in that the spacer includes at least two arms.

18. The spacer as claimed in claimed in any preceding claim characterised in that the spacer includes more than two arms.

19. The spacer as claimed in any preceding claim characterised in that the spacer is cross-shaped in cross section.

20. The spacer as claimed in any preceding claim characterised in that the spacer is L-shaped in cross section.
21. The spacer as claimed in any preceding claim characterised in that there are two or more arms, such that at least one foot extends between, and is attached to, two adjacent arms.

22. The spacer as claimed in any preceding claim characterised in that the spacer is made of an essentially incompressible material.

23. The spacer as claimed in claim 22 characterised in that the material is one or more chosen from the group consisting of stone, concrete, plastic and rubber materials.

24. The spacer as claimed in any one of the preceding claims characterised in that all or some of the material used for the spacer is configured to be dissolved once the pavers are correctly positioned.

25. A method of laying pavers using the spacer as claimed in any one of claims 1 to 24 which includes providing a suitable bedding surface, and laying on the bedding surface a plurality of pavers provided with said spacers, such that the width of each joint between a paver and an adjacent paver is determined by at least one spacer secured to at least one of the said paver and said adjacent paver.

26. The method as claimed in claim 25 characterised in that the number of spacers secured to each paver is such that each joint between one paver and an adjacent paver is provided with at least one spacer.

27. A method of laying pavers using a spacer as claimed in any one of claims 1 to 24 which includes providing a suitable bedding surface, and laying on the bedding surface a plurality of spacers which include at least one foot, such that the width of each joint between a paver and an adjacent paver is determined by at least one spacer, said foot being secured in place by at least one paver and/or said adjacent paver.

28. The method as claimed in any one of claims 25 to 27 characterised in that the number of spacers used on one side of the paver depends upon the length of that side.

30. A method as claimed in any of claims 25 to 29 characterised in that the method further comprises the use of a binder blend comprising an organic binder component and a glass component.

31. The method of claim 30, wherein the organic binder component comprises a plant-based binder, preferably wherein the binder component is derived from the plant genus Plantago, preferably psyllium.

32. The method of claims 30 or 31, wherein said glass component comprises crushed glass.

33. The method of any of claims 30 - 32, wherein the binder blend preferably comprises the plant binder component in a range of up to about 15 % by dry weight and the glass component in a range of at least about 85 % by dry weight, preferably the plant binder component is present in a range of about 1 % to about 10 % by dry weight with the glass component being present in a range of between about 99 % and about 90 % by dry weight, preferably the plant binder component is present in a range of between about 2 % and about 7.5 % by dry weight with the glass component being present in a range of between about 98 % and about 92.5 % by dry weight, preferably the plant binder component is present in a range of between about 2.5 % and about 6 % by dry weight and the glass component is present in a range of between about 97.5 % and about 94 % by dry weight, preferably the plant binder component is present at around 5 % by dry weight and the glass component is present at around 95 % by dry weight.

34. The method of any of claims 30 - 33, wherein said binder blend is to be used in combination with one or more aggregates.

35. The method of any of claims 30-34, wherein said binder blend further comprises a polymer and/or comprises granules of rubber-like material, such as synthetic rubber.

36. The method of any of claims 30-35, wherein the use of said binder blend is in combination with water.
**INTERNATIONAL SEARCH REPORT**

**International application No**
PCT/GB2012/05Q074

**A. CLASSIFICATION OF SUBJECT MATTER**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>JP 10 259601 A (TOYO SEKIZAI KK) 29 September 1998 (1998-09-29) the whole document</td>
<td>1-3, 6-9, 20, 22, 23, 25, 26, 29</td>
</tr>
<tr>
<td>X</td>
<td>DE 805 649 C (FRANKIGNOUL PI EUX ARMES) 25 May 1951 (1951-05-25) the whole document</td>
<td>1, 4, 5</td>
</tr>
<tr>
<td>X</td>
<td>DE 296 23 364 UI (MUELLER HORST DE) 2 April 1998 (1998-04-02) the whole document</td>
<td>1, 10-16, 27, 28</td>
</tr>
<tr>
<td>X</td>
<td>GB 2 303 649 A (MARSHALLS MONO LTD GB) 26 February 1997 (1997-02-26) the whole document</td>
<td>1, 17-19, 21, 27-29</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier application or patent but published on or after the international filing date
  - "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed
  - "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  - "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  - "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  - "Z" document member of the same patent family

**Date of the actual completion of the international search**
4 May 2012

**Date of mailing of the international search report**
13/08/2012

**Name and mailing address of the ISA/IB**
European Patent Office, P.B. 5816 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax. (+31-70) 340-3016

**Authorized officer**
Movadat, Robin
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>DE 92 15 921 Ul (EBENSEER BETONWERKE) 21 January 1993 (1993-01-21) the whole document</td>
<td>1,24-26</td>
</tr>
<tr>
<td>X</td>
<td>EP 2 075 376 A2 (MI LLMORE ALAN MARTIN [GB]) 1 July 2009 (2009-07-01) the whole document</td>
<td>1,11-13</td>
</tr>
<tr>
<td>X</td>
<td>EP 1 024 226 Al (FI EGE &amp; BERTOLI GMBH &amp; CO KG [DE] KOMBI LITH GMBH ENTWICKLUNG UND [DE]) 2 August 2000 (2000-08-02) the whole document</td>
<td>1,4,5</td>
</tr>
</tbody>
</table>
### INTERNATIONAL SEARCH REPORT

**International application No.**
PCT/GB2012/05Q074

**Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   - because they relate to subject matter not required to be searched by this Authority, namely:

2. □ Claims Nos.:
   - because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ Claims Nos.:
   - because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

- see additional sheet

1. □ All required additional search fees were timely paid by the applicant, this international search report covers all searchable items.

2. □ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.: 

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

   - see additional sheet(s)

**Remark on Protest**

- □ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- □ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- □ No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-29
   
   spacer and method of laying said spacer
   ---

2. claims: 30-36
   
   method of using a binder blend while laying pavers
   ---
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP 10259601 A</td>
<td>29-09-1998</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>DE 805649 C</td>
<td>25-05-1951</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>DE 29623364 U1</td>
<td>02-04-1998</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>GB 2303649 A</td>
<td>26-02-1997</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>DE 9215921 U1</td>
<td>21-01-1993</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>EP 2075376 A2</td>
<td>01-07-2009</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 59807576 D1 24-04-2003</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 1024226 A1 02-08-2000</td>
<td></td>
</tr>
</tbody>
</table>

Form PCT/ISA/210 (patent family annex) [April 2005]