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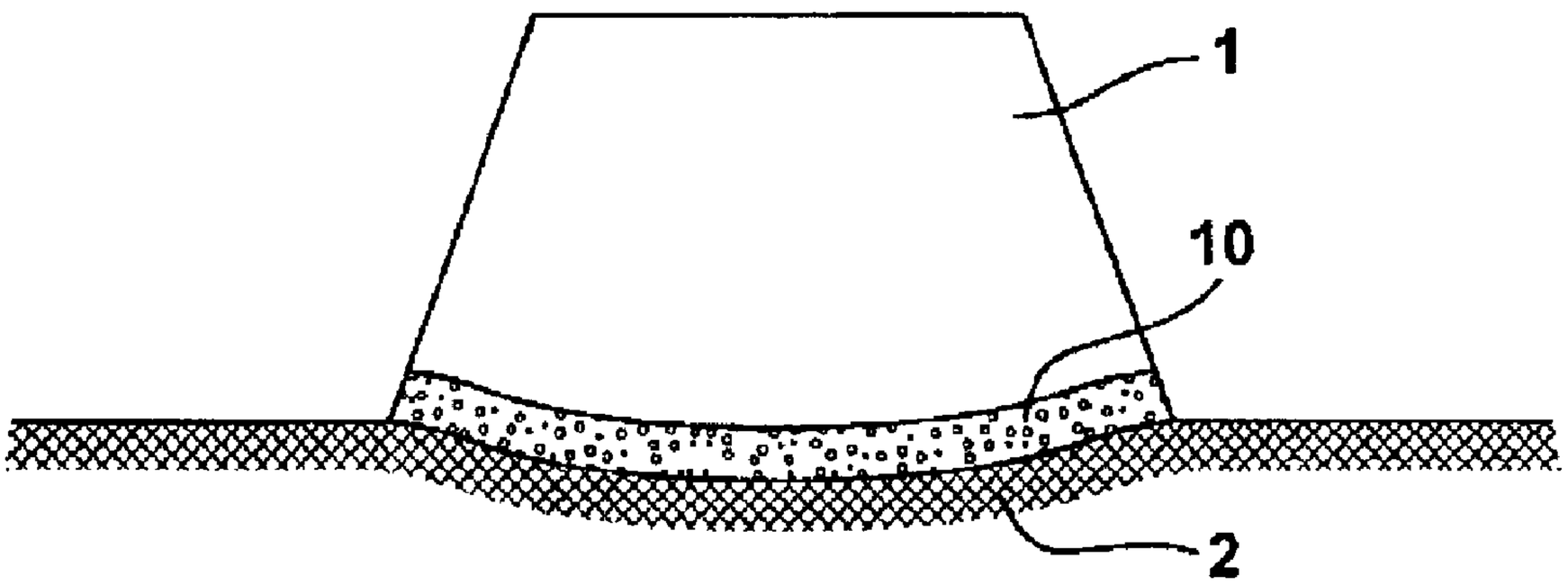
(54) **Titre : SYSTEME D'ETANCHEITE DE BASE POUR UNE DECHARGE, EN PARTICULIER UNE DECHARGE DE RESIDUS DE SEL**

(54) **Title: BASE SEAL FOR A DUMP, IN PARTICULAR A RESIDUAL SALT DUMP**



(57) **Abrégé/Abstract:**
The invention relates to a base seal for a stockpile, in particular for a residual salt stockpile, said seal comprising two layers laid on top of one another. The upper layer has a mixture of gravel, sand and bentonite or powdered clay with a permeability coefficient of $k \leq 10^{-9}$ m/s and the lower layer has a mixture of sand and bentonite or powdered clay with a permeability coefficient of $k \leq 5*10^{-10}$ m/s.

Abstract

The invention relates to a base seal of a dump, in particular a residual salt dump, said seal comprising two layers disposed on top of one another. The upper layer has a mixture of gravel, sand and bentonite or powered clay with a permeability coefficient of $k \leq 10^{-9}$ m/s and the lower layer has a mixture of sand and bentonite or powered clay with a permeability coefficient of $k \leq 5*10^{-10}$ m/s.

BASE SEAL FOR A DUMP, IN PARTICULAR A RESIDUAL SALT DUMP

Dumps or surface landfills of a whole variety of types are known, for example also residual salt dumps. Such residual salt dumps frequently have a height of more than 120 m and generate corresponding distributed loads and shear stresses. This means that due to the great weight, high normal and tangential forces are applied onto the substrate of the support surface. The consequence of this is a deformation at the base of the dump, i.e. the occurrence of subsidences and vertical displacements. In the area of the deformation, extensions and compressions of the seal system can occur. In the center of the dump, these deformations, here subsidences, are greater than in the edge area in consequence of the extra load. In the edge areas, vertical displacements also occur in addition to the subsidences. These deformations must be absorbed by the base seal system under the respective local dump conditions.

The prior art for sealing the dump basis are clay seals, which are also used in residual salt dumps. Hereby, a layer of clay with a thickness of about 0.3 m is applied onto the subsoil, onto which the dump is piled. The permeability coefficient of such a clay layer is of $k \leq 10^{-9}$ m/s. Another variant consists in a so-called enrichment of the surface soil. An enriched surface soil is a soil into which powdered clay or bentonite is incorporated with a corresponding weight proportion. Depending on the composition of the soil, the proportion of powdered clay amounts to between 3 and 10 weight percent.

In this context, it is known from EP 0 456 035 A2 in a road surfacing for drivable traffic areas, primarily in the area of gas stations, to provide below the roadbed a sealing layer made of a mixture of clay minerals, for example montmorillonite and other mineral materials. The mixture is composed of fractions of different grain sizes in such a manner that the volume of the respectively finer graining is greater than the pore volume of the respectively coarser graining and the coarsest grain of the finer graining is equal or smaller than about 1/10 of the smallest grain of the coarser graining.

From EP 0 453 619 A1, a multilayered ground is moreover known for areas in which water-polluting substances, more specifically hydrocarbons, are poured and transferred, which has a barrier layer containing bentonite.

Due to the conditions specific to the dump (high load, accumulation of salted dump water, solubility, and viscoplastic behavior of the dump material), the base seal must have a corresponding solidity that resists to the mechanical stresses and does not negatively influence the stability of the dump body. On the other hand, it must be sufficiently deformable to absorb the deformations of the ground and of the base seal caused by the extra load, without losing its effectiveness.

The object underlying the invention is therefore to provide an alternative base seal for a dump, more specifically a residual salt dump that can resist to deformations under local conditions, without a substantial deterioration of the permeability coefficient.

In order to solve the object, it is proposed according to the invention, that in a base seal of a dump, more specifically a residual salt dump, the base seal comprises two layers disposed on top of one another, the upper layer comprising a mixture of gravel, sand and bentonite or powdered clay with a permeability coefficient of $k \leq 10^{-9}$ m/s, and the lower layer has a mixture of sand and bentonite or powdered clay with a permeability coefficient of $k \leq 5*10^{-10}$ m/s. The choice between bentonite or powdered clay as a part of the mixture for forming the layer of the base seal depends on which material is actually available in sufficient quantity. When using bentonite, the proportion of smectite amounts to more than 50%, the powdered clay contains illite and smectite in different proportions. A base seal that is configured in this manner acts in the following way under the load of the dump: the upper layer of the base seal with a mixture of gravel, sand and bentonite or powdered clay constitutes a so-called graded, mineral seal, wherein the grain range of the sand amounts to between 0 and 2 mm and the grain range of the gravel between 8 and 16 mm. The lower layer that is made of sand and bentonite or powdered clay has a more ductile consistency than the upper layer. Due to the weight of the dump, stresses appear at the base, which can lead to extensions and compressions. If such a deformation occurs, it has turned out that in case of an extension of the base seal, the upper layer penetrates into the lower layer and ensures there that the base seal continues to fulfill its function. This means that the base seal regenerates itself in the course of the deformation.

Advantageous features and embodiments of the invention can be gathered from the sub-claims.

Thus, it is more specifically provided that the angle of friction of the upper layer amounts to $\varphi \geq 35°$ and that of the lower layer to $\varphi \geq 30°$. During a deformation of the base seal, which can occur vertically as well as horizontally, as a consequence of the load, the material of the mixture of the lower layer can penetrate into the underside of the upper layer and in this manner provides for a substantially unchanged permeability coefficient. In order to reduce the permeability coefficient, a polymer (for example, a long carbon chain with a high molecular weight and correspondingly active side chains) can be added to the mixture of the lower layer, which also improves salt resistance.

Furthermore, it has turned out that for the upper layer the proportion of bentonite or powdered clay in the mixture amounts to ca. 2 to 10 weight-percent, preferably 3 to 5 weight-percent of the entire mixture. The proportion of bentonite or powdered clay in the mixture for the lower layer amounts to ≥ 11 weight-percent in relation to the entire mixture. Moreover it has turned out to be advantageous if the upper layer has a thickness of ≥ 0.2 m, whereas the lower layer has a thickness of ≥ 0.1 m. At this point, it must be pointed out that the amount of powdered clay or bentonite in the mixture of the upper layer depends substantially on the grain distribution of the gravel portion. This means that the addition of powdered clay or bentonite depends on the grain distribution. In the prior art, the grain distribution is determined in laboratory tests and the bentonite or powdered clay proportion is matched with it. Therefore, it must be noted that due to the stresses, the individual layers seal off one another due to the press-fitting.

In the following, the invention is exemplarily described and submitted in more detail based on the drawings:

Figure 1	shows a schematic section of a residual salt dump;
Figure 2	schematically shows a two-layered base seal in the initial condition;
Figure 3	shows a base seal according to figure 2 after a deformation.

The residual salt dump labeled 1 stands on the subsoil 2, the base seal labeled 10 being located between the residual salt dump 1 and the subsoil 2. The base seal labeled 10 comprises the upper layer 11 and the lower layer 15. The upper layer 11 comprises a mixture of gravel, sand and bentonite or powdered clay, whereas the lower layer is thinner and

comprises sand and bentonite or powdered clay. In the representation according to figure 2, the initial condition of the base seal is shown.

It is known that the base seal can be deformed under the action of the stresses. The effectiveness of the base seal is not influenced in the deformed areas, which are compressed and compacted. In the areas that are extended and compacted, the effectiveness can increase, i.e. the permeability coefficient remains constant or decreases. The principle of the base seal according to the invention consists in that the lower layer 15, which is formed thinner and more ductile than the lower layer 16, is pressed into the lower part of the upper layer and the effectiveness of the entire base seal thus remains the same or increases.

Claims:

1. A base seal of a residual salt dump comprising two layers disposed on top of one another, the upper layer comprising a mixture of gravel with a grain range of 8 to 16 mm, sand with a grain range of 0 to 2 mm and bentonite with a permeability coefficient of $k \leq 10^{-9}$ m/s, and the lower layer having a mixture of sand with a grain range of 0 to 2 mm and bentonite with a permeability coefficient of $k \leq 5*10^{-10}$.

2. The base seal of a residual salt dump according to claim 1, wherein the proportion of bentonite in the mixture for the upper layer amounts to ca. 2 – 10 weight percent.

3. The base seal of a residual salt dump according to claim 1, wherein the proportion of bentonite in the mixture for the upper layer amounts to ca. 3 – 5 weight percent.

4. The base seal of a residual salt dump according to any one of claims 1 to 3, wherein the proportion of bentonite in the mixture for the lower layer amounts to $\geq$ 11 weight percent.

5. A base seal of a residual salt dump comprising two layers disposed on top of one another, the upper layer comprising a mixture of gravel with a grain range of 8 to 16 mm, sand with a grain range of 0 to 2 mm and powdered clay with a permeability coefficient of $k \leq 10^{-9}$ m/s, and the lower layer having a mixture of sand with a grain range of 0 to 2 mm and powdered clay with a permeability coefficient of $k \leq 5*10^{-10}$.

6. The base seal of a residual salt dump according to claim 5, wherein the proportion of powdered clay in the mixture for the upper layer amounts to ca. 2 – 10 weight percent.

7. The base seal of a residual salt dump according to claim 5, wherein the proportion of powdered clay in the mixture for the upper layer amounts to ca. 3 – 5 weight percent.

8. The base seal of a residual salt dump according to any one of claims 5 to 7, wherein the proportion of powdered clay in the mixture for the lower layer amounts to $\geq$ 11 weight percent.

9. The base seal of a residual salt dump according to any one of claims 1 to 8, wherein the friction angle of the upper layer amounts to $\varphi \geq 35°$.

10. The base seal of a residual salt dump according to any one of claims 1 to 9, wherein the friction angle of the lower layer amounts to $\varphi \geq 30$.

11. The base seal of a residual salt dump according to any one claims 1 to 10, wherein the mixture of the lower layer comprises a polymer for improving the sealing properties.

12. The base seal of a residual salt dump according to any one of claims 1 to 11, wherein the upper layer has a thickness of ≥ 0.2 m.

13. The base seal of a residual salt dump according to any one of claims 1 to 12, wherein the lower layer has a thickness of ≥ 0.1 m.

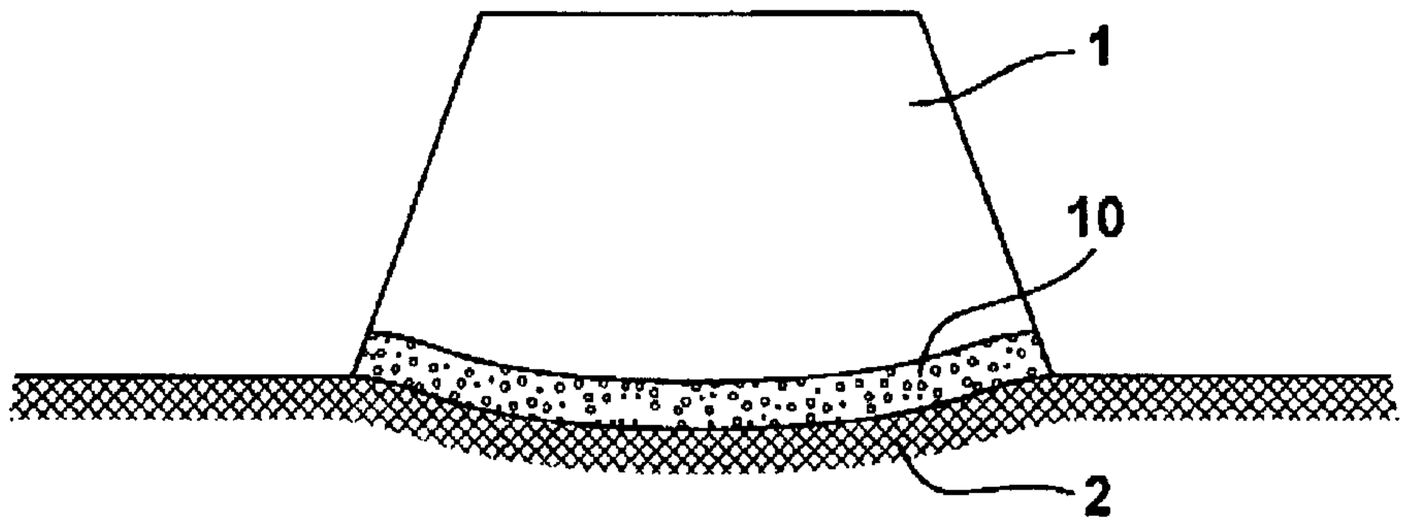


Fig. 1

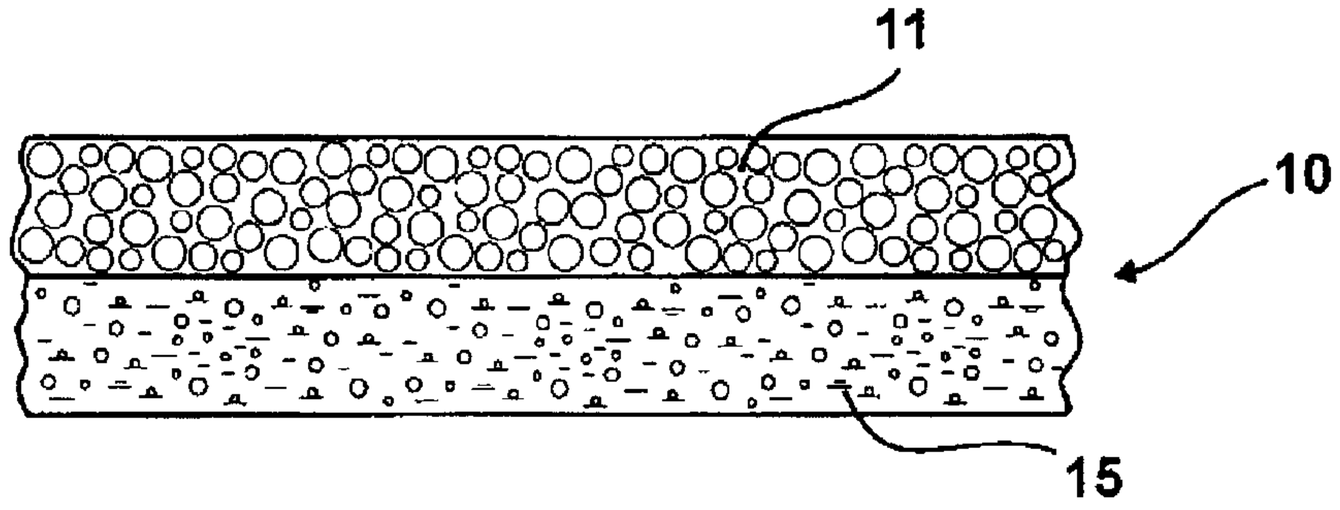


Fig. 2

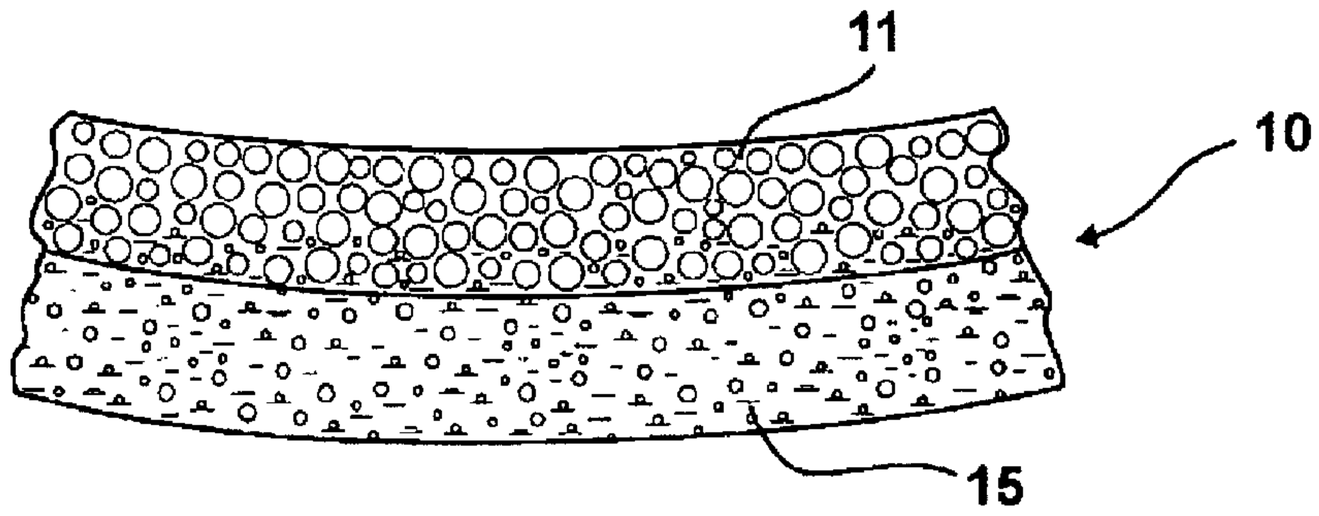
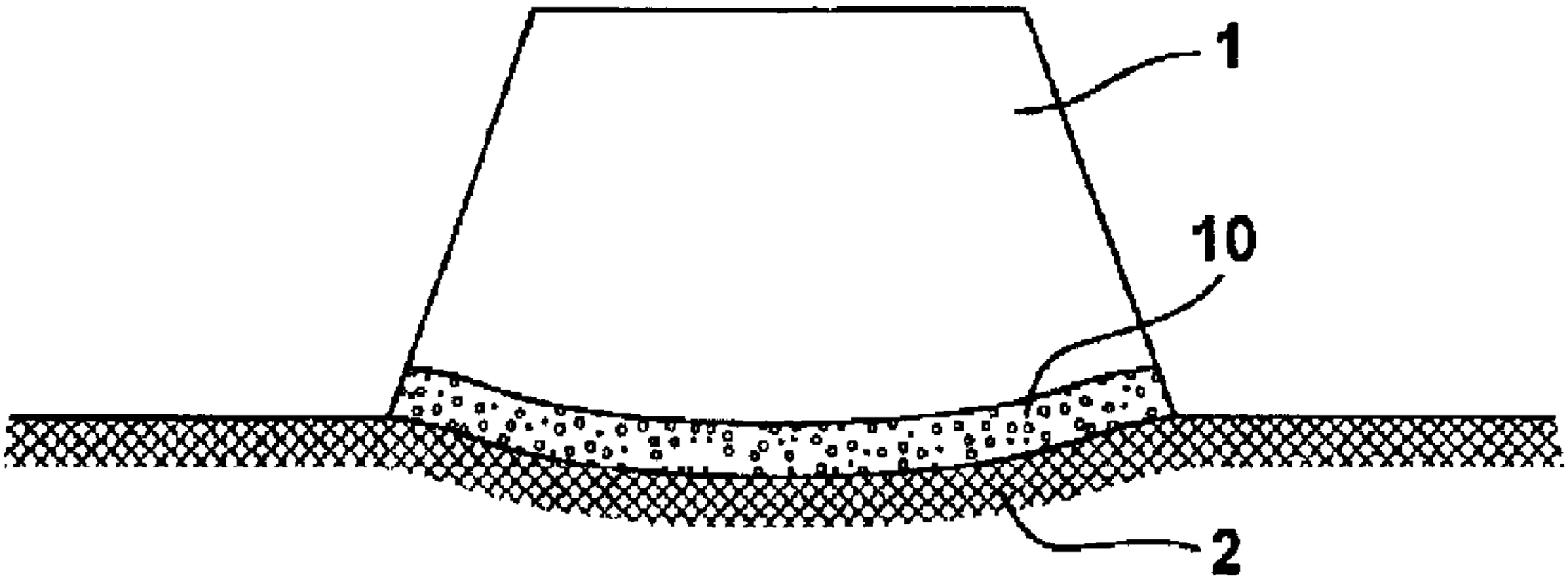


Fig. 3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