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VISCOUS AND AMINE-CURED CHEMICAL ANCHORING ADHESIVE**FIELD OF THE INVENTION**

The present invention is directed to a highly viscous (desirably amine-cured) chemical anchoring adhesive useful in industrial or commercial construction applications such as bridges, airports, highways, skyscrapers, stadiums and tunnels.

5 The anchoring adhesive maintains pins, hangars, bolts, rods, and other anchor devices firmly in place, in structural openings formed in concrete, masonry, metals (e.g., steel), ceramics, glass and wood. The chemical anchoring adhesive can be formed to a desired shape and/or cut to a desired length, before being sent to the job site or at the job site. Because of its high viscosity, the anchoring adhesive can be injected into
10 a borehole which is upside down and vertical, or horizontal, or oriented at any angle, and will not spill or flow out of the borehole.

BACKGROUND OF THE INVENTION

Chemical anchoring adhesives are known which are composed of two or more components that react together and cure when mixed. U.S. Patent 5,730,557,
15 issued to Skupian et al., discloses a mortar mixture capsule unit for chemical attachment of anchors in boreholes. The capsule houses a filler material, and a chemical binder system contained in smaller capsules within the filler material. The cartridge is inserted into a borehole, and a driving tool is used to insert an anchor. The driving tool imparts motion to the anchor, which ruptures both the housing
20 capsule and the smaller capsules contained within it, causing the chemical binder

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system to interact and mix with the filler. The interaction and mixing causes reaction and curing of the binder system/filler mixture, thereby securing the anchor within the borehole. A similar adhesive is sold by Hilti AG under the trade name "HVU".

5 U.S. Patent 5,731,366, issued to Moench et al., discloses a chemical plugging compound based on a free-radically polymerizable resin and a free-radical initiator spatially separated from the resin. The spatial separation can be effected by encapsulating the initiator in glass, gelatin or cellulose capsules. The plugging compound is described as being self-supporting and storage stable.

10 This and other prior art chemical anchoring adhesives have certain disadvantages. One disadvantage is that one or both components are fluid, and must be wrapped, encapsulated or otherwise enclosed in a package prior to use. Thus, it is not easy to vary the amount of adhesive used in a borehole, or the size of the housing capsule, while at the job site. Put another way, oversized and undersized boreholes will receive the same amount of predetermined, pre-packaged adhesive as
15 boreholes of standard size.

Another disadvantage is that the fluid adhesives may flow or spill from the boreholes during use, particularly after the package is ruptured by the anchor being driven. This problem is especially acute when the borehole is upside down and vertical, but also exists when the borehole is horizontal, or at an angle between
20 horizontal and upside down vertical. Even when the adhesive is not completely fluid,



the prior art cartridges are typically not self-retentive, i.e., the cartridges will fall from overhead boreholes.

Another disadvantage is that the two components, binder and filler, must be completely segregated prior to use, to prevent premature interaction and reaction. The encapsulation techniques used to accomplish this require some precision and expense. Also, there is no assurance that the smaller capsules used to contain the binder will remain evenly dispersed among the filler until the adhesive capsule is used. Uneven dispersion of the binder and filler can lead to uneven or inadequate adhesion of the anchor.

Cartridge adhesives are another type of prior art adhesive. Cartridge adhesives include two separate parts which are simultaneously injected into a borehole using a two-barrel caulking gun which brings the two parts together at the point of injection, whereupon they react upon entering the borehole. Disadvantages of cartridge adhesives include excessive packaging waste, excessive adhesive waste due to unmixed, unused material remaining in the caulking barrels, and insufficient viscosity, which permits the material to run out of vertical overhead boreholes, and to sag in horizontal boreholes.

SUMMARY OF THE INVENTION

The present invention is directed to an anchoring adhesive composition including two parts, both of which have a viscous, solid, putty-like consistency. The two parts can be joined side-by-side in a rope or other elongated configuration.



without encapsulating one relative to the other, and without causing significant premature reaction between the two parts. Because of their high viscosity, the two-part adhesive can be employed in an upside down vertical borehole, a horizontal borehole, or a borehole having an angle between horizontal and upside down vertical, and will not spill or flow from the borehole or sag within the borehole.

The first part of the adhesive comprises a resin. The first part has a viscosity between about 5 million and about 50 million centipoise, measured at 25°C using a Brookfield Viscometer, Model DV-3, made by Brookfield Engineering Co. This viscosity range assures that the adhesive may be formed, shaped, and/or cut with a knife, but will not flow. In one embodiment, the first part of the adhesive includes an epoxy resin (e.g., a liquid epoxy resin), and at least one particulate filler, in proportions required to achieve the desired viscosity.

Desirably, the first part of the adhesive composition includes about 20-45% by weight of a liquid epoxy resin, about 10-40% by weight of a first particulate filler preferably comprising talc, and about 40-65% by weight of a second particulate filler preferably comprising silica.

The second part of the adhesive comprises a curing agent. The second part has a viscosity between about 5 million and about 50 million centipoise, measured using the same test equipment. The viscosity of the second part is not more than 30% higher or 30% lower than the viscosity of the first part. In the one embodiment, the second part of the adhesive includes a curing compound, a curing



accelerator, and at least one particulate filler, in proportions required to achieve the desired viscosity.

Desirably, the second part of the adhesive composition comprises about 5-20% by weight of an amine or chemical derivative thereof, about 0.1-15% by weight of a tertiary amine, about 1-23% by weight of a first particulate filler preferably comprising talc, and about 52-87% by weight of a second particulate filler preferably comprising silica.

The first and second parts can be extruded, pressed, or otherwise joined together in the form of a rope having a cylindrical, rectangular, square, triangular, or other suitable shape. The rope may have any suitable cross-sectional diameter, and any suitable length. The rope may be wrapped around its circumference with a suitable wrapper of plastic film, metal foil, paper, or the like. The first and second parts are directly joined along at least one interface extending the length of the rope. By "directly joined" it is meant that no film, capsule or other barrier is interposed between the two parts.

The rope of anchoring adhesive may be cut or sheared to any size, depending on the depth of the borehole. In one embodiment, the proper amount of adhesive can be measured by the depth of the borehole, i.e., by inserting a rope end into the borehole as far as possible, and cutting the rope at the top of the borehole. If the boreholes vary in depth, the adhesive may be cut or sheared to varying lengths on the job site, to provide the optimum amount of adhesive for each borehole.



Because the two parts are extruded side-by-side, the amount of each part relative to the other is substantially consistent along the length of the rope. The only direct contact between the two parts prior to use is along a single interface. Premature reaction between them is thereby minimized without requiring encapsulation of one part relative to the other.

With the foregoing in mind, it is a feature and advantage of the invention to provide a highly viscous, two-part anchoring adhesive which can be used in a downward or horizontally-opening borehole without spilling from the borehole.

It is also a feature and advantage of the invention to provide a two-part anchoring adhesive composition having a consistent composition along its axial length, which provides consistent high-quality anchoring force in heavy construction applications, and which can be cut to any desired length on the job site, or before reaching the job site.

The foregoing and other features and advantages will become further apparent from the following detailed description of the presently preferred embodiments, read in conjunction with the accompanying drawings and examples. The detailed description, drawings and examples are illustrative rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a segment or slug of the highly viscous, essentially solid anchoring adhesive of the invention, prior to insertion into a borehole.

Fig. 2 illustrates the highly viscous adhesive composition, prior to cutting into slugs, wound up into a coiled rope.

Fig. 3 illustrates a borehole, and an anchoring pin held into the borehole, using the highly viscous adhesive composition.

Figs. 4(a)-4(i) illustrate, in cross-section, a wide variety of extruded configurations for the two parts of the adhesive composition.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

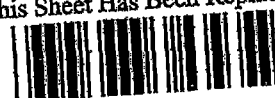
Referring to Fig. 1, a highly viscous, essentially solid phase anchoring adhesive is shown in the form of a slug 10 which is adapted for insertion into a borehole formed in concrete, steel, masonry, ceramic, glass, wood, plastic or another construction material. The slug 10 is shown as a cylinder, but may have any suitable shape and size, depending on the shape and size of the borehole. The adhesive slug 10 includes a first part 12 and a second part 14 continuously joined in face-to-face contact along interface 17, which extends the length of the slug 10. The adhesive slug 10 should contain about 20-80% by weight of each of the first and second parts 12 and 14, based on the combined weight of the first part 12 and second part 14. Preferably, the slug 10 contains about 35-75% by weight of the first part 12 and about 25-65% by weight of the second part 14, more preferably about 52-65% by weight



of the first part 12 and about 35-48% by weight of the second part 14, most preferably about 57% by weight of the first part 12 and about 43% by weight of the second part 14. The slug 10 is surrounded on its side by a wrapper 16 which may, but need not, cover the two ends 13 and 15 of slug 10.

5 The first part 12 of the adhesive slug 10 has a viscosity of about 5 million to about 50 million centipoise at 25°C, preferably about 20 million to about 45 million centipoise, more preferably about 30 million to about 40 million centipoise. The viscosity is measured using a Brookfield Viscometer, Model DV-3, made by Brookfield Engineering Co., using the procedure set forth in the
10 manufacturer's instructions. The second part 14 of the adhesive slug 10 has a viscosity of about 5 million to about 50 million centipoise at 25°C, preferably about 20 million to about 45 million centipoise, more preferably about 30 million to about 40 million centipoise. The foregoing viscosities ensure that the first and second parts
15 12 and 14 essentially have a solid phase, putty-like consistency, allowing the adhesive composition to be cut, compressed, or otherwise deformed at will, but preventing flowing, spilling and other random deformation of the adhesive composition. For example, in a horizontal borehole, the adhesive will not sag to the lower portion of the borehole or flow out. Also, the adhesive will not flow out of an overhead borehole.

20 To facilitate manufacturing of the two-part adhesive composition, and later mixing of the two parts in a borehole, the viscosities of the two parts 12 and 14



should be close to each other, and are preferably substantially matched. Generally, the viscosity of the second part 14 should be no more than 30% higher or 30% lower than the viscosity of the first part 12. Preferably, the viscosity of the second part 14 is no more than 20% higher or 20% lower than the viscosity of the first part 12. More preferably, the viscosity of the second part 14 is no more than 10% higher or 10% lower than the viscosity of the first part 12. Most preferably, the two viscosities are substantially the same.

In one embodiment, the first part 12 of the adhesive composition includes about 20-45% by weight of an epoxy resin, about 10-40% by weight of a first particulate filler, and about 40-65% by weight of a second particulate filler. Preferably, the first part 12 of the adhesive composition includes about 25-35% by weight of the epoxy resin, about 12-25% by weight of the first particulate filler, and about 45-60% by weight of the second particulate filler. More preferably, the first part 12 of the adhesive composition includes about 26-30% by weight of the epoxy resin, about 16-20% by weight of the first particulate filler, and about 52-58% by weight of the second particulate filler.

The epoxy resin is preferably a liquid epoxy derivative. Novolac epoxy resins are particularly suitable, and bisphenol epoxy resins are preferred. One particularly suitable bisphenol epoxy resin is available from Shell Chemical Co. under the trade name EPON®828. EPON®828 is a difunctional bisphenol A/epichlorohydrin



derived from liquid epoxy. Other suitable epoxy resins include ARALDITE®610, available from Ciba-Geigy; and DER 331, available from Dow Chemical Co.

5 The first particulate filler should have an oil absorption value of at least about 30, measured using ASTM D281-31. Preferably, the first particulate filler has an oil absorption of at least about 40, more preferably at least about 50. One suitable first filler is talc, having a particle size of about 1 micron to about 50 microns. One suitable talc filler is Talc 399 sold by the Whitaker, Clark & Daniels Corporation. Other suitable talcs are Mistron ZSC from Cyprus Minerals, and MP12-50 from Pfizer Chemical Co. Other suitable first particulate fillers, having similar particle size
10 ranges, include calcium carbonate, glass beads, silica, fly ash, clay, and the like. These other fillers are less desirable than talc.

The second particulate filler is different from the first, and can be defined in terms of U.S. Sieve size. At least about 70% by weight of the filler particles should have a U.S. Sieve size between 16 and 45, inclusive. Preferably, at
15 least about 80% by weight of the filler particles, and more preferably at least about 90% by weight of the filler particles, have a U.S. Sieve size between 16 and 45. Particulate filler within this size range facilitates optimum extrusion during manufacturing, excellent mixing of the adhesive during use due to action of a driving tool, shredding of the wrapper 16 during mixing, and excellent bond strength of the
20 cured adhesive. Filler having significant amounts of larger (lower U.S. Sieve size) particles provides good in-hole mixing and wrapper shredding, but causes extrusion



and/or forming difficulties during manufacture of the adhesive composition. Filler having significant amounts of smaller particles (higher U.S. Sieve size) provides excellent extrusion and/or forming during manufacture of the adhesive, but facilitates poor in-hole mixing, wrapper shredding and bond strength of the adhesive.

5 Suitable second fillers contributing to in-hole mixing of Parts A and B include silica sand, glass beads, and quartz. One particularly suitable filler is a sand, for example, a silica sand sold as AGSCO® Sand No. 1, by the Agsco Company. For this sand, about 89.4% by weight of the particles have a U.S. Sieve size between 16 and 45.

10 In the one embodiment, the second part 14 of the adhesive composition includes about 5-20% by weight of an amine compound, meaning an amine or chemical derivative thereof but not a tertiary amine, about 0.1-15% by weight of a tertiary amine compound, meaning a tertiary amine or chemical derivative thereof, about 1-23% by weight of a first particulate filler and about 52-87% by weight of a
15 second particulate filler. Preferably, the second part 14 includes about 10-18% by weight of the amine compound, about 1-10% by weight of the tertiary amine compound, about 5-18% by weight of the first particulate filler and about 58-72% by weight of the second particulate filler. More preferably, the second part 14 includes about 12-16% by weight of the amine compound, about 1-5% by weight of the
20 tertiary amine compound, about 7-12% by weight of the first particulate filler, and about 62-68% by weight of the second particulate filler.



The first and second fillers in the second part 14 are selected from the same groups of fillers as the first and second fillers in the first part 12 of the adhesive composition, and may or may not be identical to the first and second fillers in the first part 12. The amine compound acts as a curing agent once the first part 12 and second part 14 have been mixed together. The tertiary amine compound acts as an
5 accelerator for the curing reaction.

Suitable amine compounds include amines, aliphatic amines, aminoethylpiperazine, amido amines, cycloaliphatic amines, and the like. Preferred aliphatic amines include Mannich bases. One suitable Mannich base is sold by Air
10 Products Co. under the name ANCAMINE®1856. Other suitable aliphatic amines include ANCAMINE®1767 and ANCAMINE®1768.

Suitable tertiary amine compounds include ANCAMINE®110, ANCAMINE®K61B, and ANCAMINE®K54, all sold by Air Products Co., and EPICURE®3253 sold by Shell Chemical Co. A preferred tertiary amine is sold by Air
15 Products Co. under the trade name ANCAMINE®K54, and is a tris-(dimethylaminomethyl)phenol.

To manufacture the adhesive composition, the ingredients of the first part 12 can be mixed in a first mixer, and the ingredients of the second part 14 can be mixed in a second mixer. The separate mixers can be drum tumblers, sigma blade
20 mixers, planetary mixers, extrusion mixers, press mixers, and the like. Vigorous mixing, requiring shear without added heat, may be employed to ensure a



homogenous distribution of ingredients in each of the first part 12 and the second part 14. The first part 12 and second part 14 may then be extruded and/or pressed adjacent to each other, using separate extruders and/or presses that converge in a single die, to form the biconstituent adhesive composition shown in Fig. 1, having the interface 17 between first part 12 and second part 14.

The first part 12 and second part 14 of the adhesive may be extruded and/or pressed together in a wide variety of configurations. In the preferred configuration, exemplified in Fig. 4(a), the adhesive has a cylindrical or elliptical configuration, with each part 12 and 14 occupying halves of the cylinder. Other possible configurations are a sheath-core configuration (Fig. 4(b)), a quadrocylindrical configuration (Fig. 4(c)), a clover leaf configuration (Fig. 4(d)), various square and rectangular configurations (Figs. 4(e), 4(f), and 4(g)), a triangular configuration (Fig. 4(h)), and a curled configuration (Fig. 4(i)).

Once the adhesive composition has been extruded, it may be covered with a wrapper 16 made of plastic, aluminum foil, paper, or the like. Preferably, the wrapper 16 is made of a polyolefin material, most preferably high density polyethylene or polypropylene. The adhesive composition may then be cut into individual slugs 10 as shown in Fig. 1, or may be stored as a coiled rope 20 as shown in Fig. 2. When stored as a rope 20, the adhesive composition may be cut into individual slugs 10, having any desired sizes, at the construction site or before entering the construction site.



At the construction site, a slug 10 is inserted into a borehole 32 formed in a structure 30 as shown in Fig. 3. A driving tool (not shown) is used to drive an anchor pin 34 into the borehole 32. A typical anchor pin 34 may be threaded, and may have a flat or pointed forward end 35. A typical driving tool uses rapid rotational motion to spin the anchor pin into the borehole. Some driving tools employ a combination of hammering (axial motion) and/or rotational motion.

If the adhesive rope is manufactured with the proper diameter with respect to the diameter of the borehole, and the diameter of the pin, the correct amount of adhesive can be measured by inserting an adhesive rope as far as possible into the borehole, and cutting the rope at the top of the borehole. In effect, the adhesive slug can be formed *in situ* at the job site.

The movement of the driving tool, and consequent motion of the anchor pin 34, causes disintegration of the wrapper 16 and mixing of the first part 12 and second part 14 of adhesive slug 10, within the borehole. The threads on the anchor pin 34 aid in the mixing. As the anchor pin 34 is driven into the borehole 32, the entire adhesive slug 10 is blended into a substantially homogeneous mixture 18 which fills most of the spaces between anchor pin 34 and the inner walls of borehole 32. The mixing action also causes substantial curing of the mixture 18 to firmly secure the anchor pin 34 within borehole 32.

Examples



A highly viscous, essentially solid phase adhesive composition having the configuration shown in Figs. 1 and 4(a) was prepared, using the following compositions for the first part and the second part, and a weight ratio of 4:3 for the first and second parts. The reason for having more of the first part than the second part is to maintain about 5% less than a stoichiometric balance of hardener in the second part to resin in the first part. Unreacted hardener may facilitate creep of the anchoring adhesive, and the amount of unreacted hardener is minimized by this technique. The first part had a viscosity of 40 million centipoise. The second part had a viscosity of 40 million centipoise. The composition was extruded into a rope having a 0.5-inch diameter. The extruded rope was wrapped in high density polyethylene film having a thickness of 0.5 mil, and was cut into slugs having a length of 4.5 inches.

First Part (Resin)	
Material	% By Weight
EPON®828 (Bisphenol A Epoxy Resin)	28.00
Talc 399 (Whitaker, Clark & Daniels)	17.30
AGSCO® Sand #1 (silica sand)	54.70
Total: 100.00	

Second Part (Hardener)	
Material	% By Weight
ANCAMINE®1856 (modified aliphatic amine)	14.67
ANCAMINE®K54 (tertiary amine)	1.73



Talc 399	9.33
AGSCO® Sand #1	65.34
Total: 100.00	

5 The inventive, highly viscous, essentially solid-phase adhesive, called
EXP 220, was evaluated against two prior art epoxy-based liquid adhesives sold by
ITW Ramset/Redhead under the names Granite 5 and Ceramic 6. The adhesives were
evaluated using 0.5 in. diameter steel anchor rods, and 0.563 in. x 4.5 in. boreholes
formed in 4000 psi compressive strength concrete. The anchor rods had 1.5-degree
10 tapered threads. The hand-operated driving tool was run at 1600 rpm.

Pullout strengths from dry concrete at ambient temperature were
measured at various time intervals after insertion of the anchors, up to 24 hours.
Pullout strengths were also measured for concrete which had been under water for 24
hours before and after insertion of the anchors. Pullout strengths were also measured
15 for dry concrete which was maintained at 110°F for 24 hours before and after
insertion of the anchors. The pullout strengths, which are reported in pounds of force,
were measured using an Instron load tester. Table 1 shows the pullout strengths
resulting from these tests.

Table 1: Pullout Strengths (Pounds)

Example No.	Adhesive	Dry Concrete, 4 Hours	Dry Concrete, 24 hours	Wet Concrete, 24 Hours	Dry Concrete, 110°F, 24 Hours
1	EXP 220 (Inventive)	15,900	16,000	12,500	14,450



2	Granite 5 (Comparative)	5,900	15,700	12,500	8,500
3	Ceramic 6 (Comparative)	17,300	17,900	13,500	16,300

As shown above, the highly viscous adhesive composition of the invention produced an anchoring force higher than one of the prior art liquid epoxy adhesives, and equivalent to another. Also, the adhesive composition of the invention remained essentially odor-free during use.

In a second set of experiments performed under similar conditions at a different time and location, using similar 4000 psi concrete, the same inventive adhesive composition was tested using the same procedure, versus a) white epoxy putty sticks manufactured by Devcon Co. and sold by Ace Hardware Corp. and others, and b) HVU adhesive made and sold by Hilti AG of Waldstetlen, Germany.

The white epoxy putty sticks are typically used for repairs, and are not considered to be an anchoring adhesive. On information and belief, the HVU adhesive is similar to that described in U.S. Patent 5,731,366, issued to Moench et al. The HVU adhesive contains a loose filler phase and a liquid chemical phase contained in capsules dispersed in the filler phase. Both phases are contained in a cylindrical plastic wrapper.

Table 2 shows the average holding strength for each of three adhesives, measured after 24 hours in dry, ambient temperature concrete.

Table 2: Pullout Strengths (Pounds)



Example No.	Adhesive	Dry Concrete, 24 Hours
4	EXP 220 (Inventive)	12,291
5	Devcon putty sticks (Comparative)	5,382
6	Hilti HVU (Comparative)	12,538

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As shown above, the inventive highly viscous adhesive composition gave better holding force than the prior art putty sticks and similar holding force to the prior art fluid /capsule adhesive system.

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While the embodiments of the invention described herein are presently preferred, various modifications and improvements can be made without departing from the spirit and scope of the invention. The scope of the invention is indicated by the appended claims, and all changes that fall within the meaning and range of equivalents are intended to be embraced therein.





WE CLAIM:

1. An anchoring adhesive, comprising:
a first part comprising a resin, and having a viscosity of about 5 million to about 50 million centipoise; and
a second part comprising a curing agent, and having a viscosity of about 5 million to about 50 million centipoise;
the first and second parts being directly joined along an interface.
2. The anchoring adhesive of Claim 1, wherein the first part has a viscosity of about 20 million to about 45 million centipoise, and the second part has a viscosity of about 20 million to about 45 million centipoise.
3. The anchoring adhesive of Claim 1, wherein the first part has a viscosity of about 30 million to about 40 million centipoise, and the second part has a viscosity of about 30 million to about 40 million centipoise.
4. The anchoring adhesive of Claim 1, wherein the resin comprises an epoxy resin.
5. The anchoring adhesive of Claim 1, wherein the first part further comprises a particulate filler.





6. The anchoring adhesive of Claim 1, wherein the curing agent comprises an amine compound.

7. The anchoring adhesive of Claim 6, wherein the second part further comprises a tertiary amine compound.

8. The anchoring adhesive of Claim 1, wherein the second part further comprises a particulate filler.

9. The anchoring adhesive of Claim 4, wherein the curing agent comprises an amine compound.

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10. The anchoring adhesive of Claim 1, wherein:

a) the first part comprises about 20-45% by weight of an epoxy resin, about 10-40% by weight of a first particulate filler having an oil absorption value of at least about 30, and about 40-65% by weight of a second particulate filler, at least about 70% by weight of the second particulate filler having a U.S. Sieve size between 16 and 45, inclusive; and

b) the second part comprises about 5-20% by weight of an amine compound, about 0.1-15% by weight of a tertiary amine compound, about 1-23% by weight of a first particulate filler having an oil absorption value of at least about 30, and about 52-87% by weight of a second particulate filler, at least about 70% by weight of the second particulate filler having a U.S. Sieve size between about 16 and 45.

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11. An anchoring adhesive, comprising:

a) a first part comprising about 20-45% by weight of an epoxy resin, about 10-40% by weight of a first particulate filler having an oil absorption value of at least about 30, and about 40-65% by weight of a second particulate filler, at least about 70% by weight of the second particulate filler having a U.S. Sieve size between 16 and 45, inclusive; and

b) a second part comprising about 5-20% by weight of an amine compound, about 0.1-15% by weight of a tertiary amine compound, about 1-23% by weight of a first particulate filler having an oil absorption value of at least about 30, and about 52-87% by weight of a second particulate filler, at least about 70% by weight of the second particulate filler having a U.S. Sieve size between about 16 and 45.

12. The anchoring adhesive of Claim 11, wherein the first part comprises about 25-35% by weight of the epoxy resin, about 12-25% by weight of the first particulate filler, and about 45-60% by weight of the second particulate filler.

13. The anchoring adhesive of Claim 11, wherein the first part comprises about 26-30% by weight of the epoxy resin, about 16-20% by weight of the first particulate filler, and about 52-58% by weight of the second particulate filler.





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14. The anchoring adhesive of Claim 11, wherein the second part comprises about 10-18% by weight of the amine compound, about 1-10% by weight of the tertiary amine compound, about 5-18% by weight of the first particulate filler and about 58-72% by weight of the second particulate filler.

15. The anchoring adhesive of Claim 11, wherein the second part comprises about 12-16% by weight of the amine compound, about 1-5% by weight of the tertiary amine compound, about 7-12% by weight of the first particulate filler, and about 62-68% by weight of the second particulate filler.

16. The anchoring adhesive of Claim 11, comprising about 20-80% by weight of the first part and about 20-80% by weight of the second part.

17. The anchoring adhesive of Claim 11, comprising about 35-75% by weight of the first part and about 25-65% by weight of the second part.

18. The anchoring adhesive of Claim 11, comprising about 52-65% by weight of the first part and about 35-48% by weight of the second part.

19. The anchoring adhesive of Claim 11, wherein the epoxy resin comprises a novolac epoxy resin.





20. The anchoring adhesive of Claim 11, wherein the epoxy resin comprises a bisphenol epoxy resin.

21. The anchoring adhesive of Claim 11, wherein the epoxy resin comprises a difunctional bisphenol A/epichlorohydrin.

22. The anchoring adhesive of Claim 11, wherein the first particulate filler in the first part and the first particulate filler in the second part comprise the same material.

23. The anchoring adhesive of Claim 11, wherein the second particulate filler in the first part and the second particulate filler in the second part comprise the same material.

24. The anchoring adhesive of Claim 11, wherein the first particulate fillers each comprise a material selected from talc, calcium carbonate, glass beads, silica, fly ash, clay, and combinations thereof.

25. The anchoring adhesive of Claim 11, wherein at least one of the first particulate fillers comprises talc.





26. The anchoring adhesive of Claim 11, wherein each of the second particulate fillers comprises a material selected from quartz, silica, glass beads, and combinations thereof.

27. The anchoring adhesive of Claim 11, wherein at least one of the second particulate fillers comprises silica sand.

28. The anchoring adhesive of Claim 11, wherein the amine compound comprises a compound from the group consisting of amines, aliphatic amines, aminoethylpiperazine, amido amines, cycloaliphatic amines, and combinations thereof.

29. The anchoring adhesive of Claim 11, wherein the amine compound comprises an aliphatic amine compound.

30. The anchoring adhesive of Claim 11, wherein the amine compound comprises a Mannich base.

31. The anchoring adhesive of Claim 11, wherein the tertiary amine compound comprises tris-(dimethylaminomethyl)phenol.





32. An anchoring adhesive, comprising:
about 20-80% by weight of a first part comprising an epoxy resin, and
having a viscosity of about 20 million to about 45 million centipoise; and
about 20-80% by weight of a second part comprising a curing agent,
and having a viscosity between about 30% lower and about 30% higher than the
viscosity of the first part.

33. The anchoring adhesive of Claim 32, wherein the second part has
a viscosity between about 20% lower and about 20% higher than the viscosity of the
first part.

34. The anchoring adhesive of Claim 32, wherein the second part has
a viscosity between about 10% lower and about 10% higher than the viscosity of the
first part.

35. The anchoring adhesive of Claim 32, comprising about 52-65%
by weight of the first part and about 35-48% by weight of the second part.





36. The anchoring adhesive of Claim 32, wherein:

a) the first part comprises about 20-45% by weight of the epoxy resin, about 10-40% by weight of a first particulate filler having an oil absorption value of at least about 30, and about 40-65% by weight of a second particulate filler, at least about 70% by weight of the second particulate filler having a U.S. Sieve size between 16 and 45, inclusive; and

b) the second part comprises about 5-20% by weight of an aliphatic amine compound, about 0.1-15% by weight of a tertiary amine compound, about 1-23% by weight of a first particulate filler having an oil absorption value of at least about 30, and about 52-87% by weight of a second particulate filler, at least about 70% by weight of the second particulate filler having a U.S. Sieve size between about 16 and 45.

