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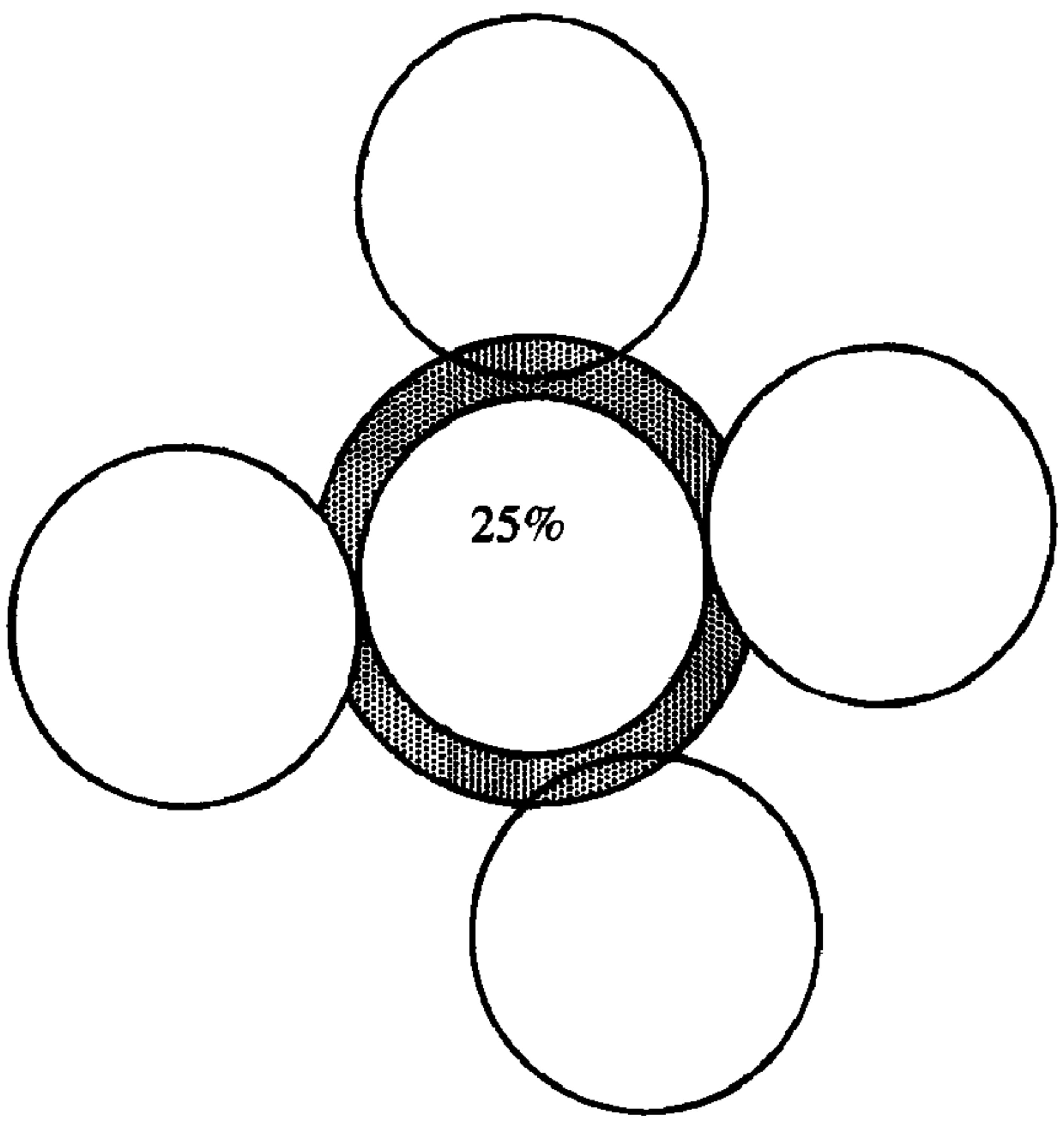

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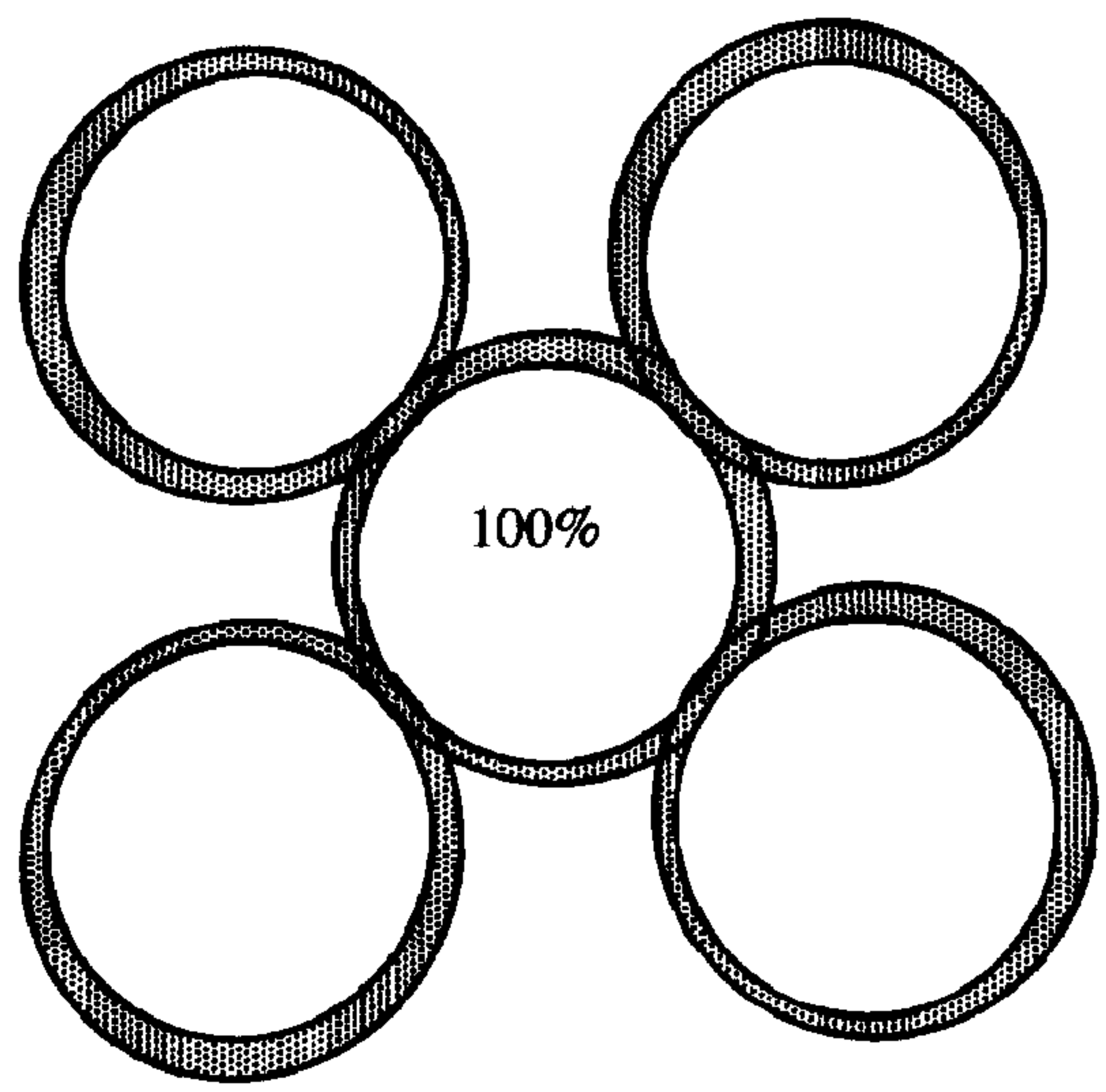

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A method of consolidating particulates comprising providing a slurry comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with resin or tackifying agent and wherein the second portion of particulates is substantially free of resin or tackifying agent; introducing the slurry into a portion of a subterranean formation such that the first portion of particulates and second portion of particulates to form a particulate pack in the portion of the subterranean formation; and, allowing the resin to substantially consolidate the particulate pack. A particulate slurry for use in subterranean formations comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with resin or tackifying agent and wherein the second portion of particulates is substantially free of resin or tackifying agent.

METHODS OF COATING RESIN AND BLENDING RESIN-COATED PROPPANT

ABSTRACT

A method of consolidating particulates comprising providing a slurry comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with resin or tackifying agent and wherein the second portion of particulates is substantially free of resin or tackifying agent; introducing the slurry into a portion of a subterranean formation such that the first portion of particulates and second portion of particulates to form a particulate pack in the portion of the subterranean formation; and, allowing the resin to substantially consolidate the particulate pack. A particulate slurry for use in subterranean formations comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with resin or tackifying agent and wherein the second portion of particulates is substantially free of resin or tackifying agent.

METHODS OF COATING RESIN AND BLENDING RESIN-COATED PROPPANT

BACKGROUND

The present invention relates to methods and compositions for consolidating particulates in subterranean formations. More particularly, the present invention relates to methods of coating particulates with consolidating agents and blending consolidating agent-coated particulates.

Subterranean operations often use particulates coated with consolidating agents such as tackifying agents and/or resins. One example of a production stimulation operation using coated particulates is hydraulic fracturing, wherein a formation is treated to increase its permeability by hydraulically fracturing the formation to create or enhance one or more cracks or "fractures." In most cases, a hydraulic fracturing treatment involves pumping a proppant-free, viscous fluid (known as a pad fluid) into a subterranean formation faster than the fluid can escape into the formation so that the pressure in the formation rises and the formation breaks, creating an artificial fracture or enlarging a natural fracture. Then a proppant is generally added to the fluid to form a slurry that is pumped into the fracture to prevent the fracture from closing when the pumping pressure is released. A portion of the proppant may be coated with a tackifying agent, *inter alia*, to prevent fines from migrating into the proppant pack. A portion of the proppant may also be coated with curable resin so that, once cured, the placed proppant forms a consolidated mass and prevents the proppant from flowing back during production of the well.

An example of a well completion operation using a treating fluid containing coated particulates is gravel packing. Gravel packing treatments are used, *inter alia*, to reduce the migration of unconsolidated formation particulates into the well bore. In gravel packing operations, particles known in the art as gravel are carried to a well bore by a hydrocarbon or water carrier fluid. That is, the particulates are suspended in a carrier fluid, which may be viscosified, and the carrier fluid is pumped into a well bore in which the gravel pack is to be placed. The carrier fluid leaks off into the subterranean zone and/or is returned to the surface while the particulates are left in the zone. The resultant gravel pack acts as a filter to separate formation sands from produced fluids while permitting the produced fluids to flow into the well bore. A portion of the gravel may be coated with resin or tackifying agent, *inter alia*, to further help control the migration of formation fines. Typically, gravel pack operations involve placing a gravel pack screen in the well bore and packing the surrounding annulus between the screen and the well bore with gravel designed to prevent the passage of formation sands through the pack. The gravel pack screen is generally a type of filter assembly used to support and retain the gravel placed during the gravel pack operation. A wide range of sizes and screen configurations are available to suit the characteristics of a particular well bore, the production fluid, and the subterranean formation sands. When installing the gravel pack, the gravel is carried to the formation in the form of a slurry by mixing the gravel with a viscosified carrier fluid. Once the gravel is placed in the well bore, the viscosity of the carrier fluid is reduced, and it is returned to the surface. Such gravel packs may be used to stabilize the formation while causing minimal impairment to well productivity. The gravel, *inter alia*, acts to prevent formation sands from occluding the screen or migrating with the produced fluids, and the screen, *inter alia*, acts to prevent the gravel from entering the well bore.

In some situations the processes of hydraulic fracturing and gravel packing are combined into a single treatment to provide stimulated production and an annular gravel pack to reduce formation sand production. Such treatments are often referred to as "frac pack" operations. In some cases, the treatments are completed with a gravel pack screen assembly in place, and the hydraulic fracturing treatment being pumped through the annular space between the casing and screen. In such a situation, the hydraulic fracturing treatment usually ends in a screen out condition creating an annular gravel pack between the screen and casing. This allows both the hydraulic fracturing treatment and gravel pack to be placed in a single operation.

SUMMARY OF THE INVENTION

The present invention relates to methods and compositions for consolidating particulates in subterranean formations. More particularly, the present invention relates to methods of coating particulates with consolidating agents and blending consolidating agent-coated particulates.

Some embodiments of the present invention provide methods of consolidating particulates comprising providing a slurry comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with resin and wherein the second portion of particulates is substantially free of resin; introducing the slurry into a portion of a subterranean formation such that the first portion of particulates and second portion of particulates form a particulate pack in the portion of the subterranean formation; and, allowing the resin to substantially consolidate the particulate pack.

Other embodiments of the present invention provide methods of consolidating particulates comprising providing a slurry comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with tackifying agent and wherein the second portion of particulates is substantially free of tackifying agent; introducing the slurry into a portion of a subterranean formation such that the first portion of particulates and second portion of particulates form a particulate pack in the portion of the subterranean formation; and, allowing the tackifying agent to substantially consolidate the particulate pack.

Other embodiments of the present invention provide particulate slurries for use in subterranean formations comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with resin and wherein the second portion of particulates is substantially free of resin.

Other embodiments of the present invention provide particulate slurries for use in subterranean formations comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with tackifying agent and wherein the second portion of particulates is substantially free of tackifying agent.

The features and advantages of the present invention will be readily apparent to those skilled in the art upon a reading of the description of the preferred embodiments that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a stylized view of the distinction between a traditional resin coating (b) and the resin coatings of the present invention (a).

DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention relates to methods and compositions for consolidating particulates in subterranean formations. More particularly, the present invention relates to methods of coating particulates with consolidating agents and blending consolidating agent-coated particulates.

While it has been previously believed that in order to achieve strong, solid, conductive particulate packs it was necessary to coat as great a percentage of the particulates as possible, we have found that it is actually more beneficial to coat only a portion of the particulates, but to coat more heavily that portion with a relatively larger weight percentage of consolidating agent than has been previously used. By using a substantially homogeneous mixture of relatively heavily coated particulates and uncoated particulates to create a particulate pack, particular embodiments of the methods of the present invention offer economical approaches to coating particulates with resin while maintaining or enhancing the consolidation strength of the particulate pack.

In particular embodiments of the present invention, a first portion of particulates, typically ranging from about 10% to about 60% by weight of the total amount of particulates, is coated with a consolidating agent; then the consolidating agent-coated first portion of particulates is combined with a servicing fluid (such as a fracturing fluid or gravel packing fluid) with the remainder of the (uncoated) particulates (90% to 40% uncoated, depending on the percentage of consolidating agent-coated proppant). The mixing of the consolidating agent-coated and uncoated particulates in the servicing fluid allows the coated particulates to be distributed among the uncoated particulates. In certain embodiments, the resin consolidating agent-coated and uncoated particulates are substantially uniformly intermingled in the servicing fluid. When introduced into a subterranean fracture, the mixture of coated and uncoated particulates cures to form a particulate pack that may exhibit a consolidation strength equivalent to, and often even higher than, a traditional particulate pack comprised entirely of coated particulates.

Contributing to this enhanced consolidation strength is the fact that particular embodiments of the present invention use coated particulates that feature a thicker coating of consolidating agent than those found in traditional subterranean applications. For example, in traditional applications, consolidating agent-coated particulates are normally coated with a consolidating agent in an amount in the range of 3% to 5% by weight of the particulates. However, in particular embodiments of the present invention, the particulates used may be coated with a consolidating agent in an amount of at least about 5%, or in the range of from about 5.5% to about 50% by weight of the particulates. In other embodiments, the particulates used may be coated with a consolidating agent in an amount of at least about 7%. In other embodiments, the particulates used may be coated with a consolidating agent in an amount of at least about 10%. In other embodiments, the particulates used may be coated with a consolidating agent in an amount of at least about 15%. In accordance with certain methods of the present invention, one method of achieving such greater coatings of consolidating agent without greatly increasing costs is to use the same amount of consolidating agent that would be used to coat an entire batch of particulates in a traditional subterranean application, but use that amount of consolidating agent to coat only a fraction of the total amount of particulates.

The greater coating of consolidating agent on the first (coated) portion of the particulates may have numerous benefits. By coating only a portion of the particulates with this greater coating, more consolidating agent is concentrated at the contact points between the grains of particulates. This may allow the consolidating agent to build stronger grain-to-grain adhesions. Additionally, it is believed that the thicker coating of consolidating agent on the particulate may help to create larger interstitial spaces between the individual particulates. These larger interstitial spaces, or voids, may help enhance the conductivity of the particulate packs without reducing their consolidation strength. A stylized view of the distinction between the traditional consolidating agent coating and the consolidating agent coatings of the present invention is provided in Figure 1. Figure 1(a) illustrates a situation wherein only about 20-25% of the particulates is coated with consolidating agent, but that percentage is coated with a relatively greater coating of consolidating agent. Figure 1(b) illustrates a situation wherein about 90-100% of the particulates are coated with a traditional thickness coating of consolidating agent. In Figures 1(a) and 1(b), the same amount of consolidating agent has been used to coat, but in Figure 1(a) all of the consolidating agent is on one particulate while in Figure 1(b) the resin is spread among five particulates.

The methods of the present invention may be used, *inter alia*, such that the total volume of consolidating agent used is less than that traditionally needed to effect good consolidation, thus resulting in a direct cost decrease due to the use of less consolidating agent. Alternatively, as described above, the methods of the present invention may use the same amount of consolidating agent coated on a smaller portion of the particulates, in that case while a direct cost benefit of reduced consolidating agent usage may not be seen, cost savings may still occur due to the fact that coating fewer particulates may result in simplified operating procedures, reduced horsepower requirement, and reduced equipment usage. It is within the ability of one skilled in the art to determine the minimum level of consolidation needed for a job and to select the level of consolidating agent accordingly. For example, when using curable resins, consolidation strengths (when considered in terms term of unconfined compressive strengths, UCC) may range from about 20 psi to 2,000 psi, depending on the resin concentration, cure time, and cure temperature.

Particulates used in accordance with the present invention are generally of a size such that formation sands that may migrate with produced fluids are prevented from being produced from the subterranean zone. Any suitable proppant or gravel may be used, including, but not limited to, graded sand, bauxite, ceramic materials, glass materials, walnut hulls, nut shells, polymer beads, and the like. Generally, the particulates have a size in the range of from about 4 to about 400 mesh, U.S. Sieve Series. In some embodiments of the present invention, the particulates are graded sand having a particle size in the range of from about 10 to about 70 mesh, U.S. Sieve Series.

As mentioned above, in accordance with the preferred methods of the present invention, only a portion of the total amount of proppant is coated with consolidating agent. In certain particular embodiments of the present invention, the particulates may be purchases as pre-coated from a commercial supplier (RCP). Suitable commercially available RCP materials include, but are not limited to, pre-cured resin-coated sand, curable resin-coated sand, curable resin-coated ceramics, single-coat, dual-coat, or multi-coat resin-coated sand, ceramic, or bauxite. Some examples available from Borden Chemical, Columbus, Ohio, are "XRT™ CERAMAX P," "CERAMAX I," "CERAMAX P," "ACFRAC BLACK," "ACFRAC CR," "ACFRAC SBC," "ACFRAC SC," and "ACFRAC LTC." Some examples available from Santrol, Fresno, Texas, are "HYPERPROP G2," "DYNAPROP G2," "MAGNAPROP G2," "OPTIPROP G2," "SUPER HS," "SUPER DC," "SUPER LC," and "SUPER HT." Typically, these products come from the supplier with a coating of resin in an amount in the range of about 3% to about 5% by weight of the proppant. However, as mentioned above, embodiments of the present invention generally employ a greater coating of than traditional RCP materials may be coated with consolidating agent in an amount of at least about 5%, or in the range of from about 5.5% to about 50% by weight of the particulates. In other embodiments, the particulates used may be coated with a consolidating agent in an amount of at least about 7%. In other embodiments, the particulates used may be coated with a consolidating agent in an amount of at least about 10%. In other embodiments, the particulates used may be coated with a consolidating agent in an amount of at least about 15%.

One suitable type of consolidating agent is a resin. Suitable resin compositions include those resins that are capable of forming a hardened, consolidated mass. Suitable resins include, but are not limited to, two-component epoxy-based resins, novolak resins, polyepoxide resins, phenol-aldehyde resins, urea-aldehyde resins, urethane resins, phenolic resins, furan/furfuryl alcohol resins, phenolic/latex resins, phenol formaldehyde resins, polyester resins and hybrids and copolymers thereof, polyurethane resins and hybrids and copolymers thereof, acrylate resins, and mixtures thereof. Some suitable resins, such as epoxy resins, may be of the two-component variety mentioned above and use an external catalyst or activator. Other suitable resins, such as furan resins generally require a time-delayed catalyst or an external catalyst to help activate the polymerization of the resins if the cure temperature is low (*i.e.*, less than 250°F), but will cure under the effect of time and temperature if the formation temperature is above about 250°F, preferably above about 300°F. Selection of a suitable resin coating material may be affected by the temperature of the subterranean formation to which the fluid will be introduced. By way of example, for subterranean formations having a bottom hole static temperature ("BHST") ranging from about 60°F to about 250°F, two-component epoxy-based resins comprising a hardenable resin component and a hardening agent component containing specific hardening agents may be preferred. For subterranean formations having a BHST ranging from about 300°F to about 600°F, a furan-based resin may be preferred. For subterranean formations having a BHST ranging from about 200°F to about 400°F, either a phenolic-based resin or a one-component HT epoxy-based resin may be suitable. For subterranean formations having a BHST of at least about 175°F, a phenol/phenol formaldehyde/furfuryl alcohol resin also may be suitable. It is within the ability of one skilled in the art, with the benefit of this disclosure, to select a suitable resin for use in embodiments of the present invention and to determine whether a catalyst is required to trigger curing.

As mentioned above, particular embodiments of the present invention may employ an activator, or external catalyst, to trigger the curing of certain resin compositions, for example, two-component epoxy resins. In an exemplary embodiment, such an activator may be delivered by at least partially coating the non-resin-coated portion of the particulates with the activator prior to mixing the two portions of particulates together. Once mixed with the resin-coated particulates, the activator may trigger the curing of the resin, facilitating the consolidation of the particulates. When applied to the non-resin-coated portion of the particulates, the activator is typically present in an amount in the range of from about 0.01% to about 25% by weight of the particulates. Activators suitable for use in accordance with the present invention may depend on the resin employed in a particular embodiment. Examples of suitable activators include an alcohol; a ketone; an ester; an ether; an amide; benzene sulfonic acid; sulfuric acid; methane sulfonic acid; trichloroacetic acid; hydrochloric acid; hydrofluoric acid; ferric chloride; toluene sulfonic acid; chlorobenzene sulfonic acid; nitric acid; perchloric acid; a water soluble multivalent metal salt catalyst comprising at least one multivalent ion of either manganese, zinc, cadmium, magnesium, cobalt, nickel, copper, tin, iron, lead, or calcium; and combinations thereof. With the benefit of this disclosure, it is within the ability of one skilled in the art to select an activator appropriate for use with a selected resin, should an activator be necessary, and the amount necessary to trigger curing.

Similarly, particular embodiments of the present invention may also employ a curing agent to facilitate the curing of the resin. In an exemplary embodiment, such a curing agent may be delivered by at least partially coating the non-resin-coated portion of the particulates with the curing agent prior to mixing the two portions of particulates together. Once mixed with the coated particulates, the curing agent may facilitate the curing of the resin, and therefore the consolidation of the particulates. When applied to the non-resin-coated portion of the particulates, the curing agent is typically present in an amount in the range of from about 0.01% to about 25% by weight of the particulates. Curing agents suitable for use in accordance with the present invention may depend on the resin employed in a particular embodiment. Examples of suitable curing agents include amines, polyamines, amides, polyamides, hexachloroacetone, 1,1,3-trichlorotrifluoroacetone, benzotrichloride, benzylchloride, benzalchloride, 4,4'-diaminodiphenyl sulfone, and combinations thereof. With the benefit of this disclosure, it is within the ability of one skilled in the art to select a curing agent appropriate for use with a selected resin, should a curing agent be necessary, and the amount necessary to trigger curing.

In particular embodiments of the present invention, the consolidating agent may be a tackifying agent. In other embodiments, the consolidating agent may be a combination of resin and tackifying agent. When used in conjunction with resin coated particulates, a tackifying agent is typically applied after the application of the resin in an amount of from about 2% to about 10% by weight of the particulates. When used in place of a resin, the tackifying agent is typically present in an amount of from about 5% to about 25% by weight of the particulates.

Compositions suitable for use as tackifying agents in accordance with the present invention comprise any compound that, when in liquid form or in a solvent solution, will form a non-hardening coating upon a particulate. In particular embodiments, tackifying agents may include polyamides that are liquids or in solution at the temperature of the subterranean formation such that they are, by themselves, non-hardening when introduced into the subterranean formation. One such compound is a condensation reaction product comprised of commercially available polyacids and a polyamine. Such commercial products include compounds such as mixtures of C_{36} dibasic acids containing some trimer and higher oligomers and also small amounts of monomer acids produced from fatty acids, maleic anhydride, and acrylic acid, and the like. Such acid compounds are commercially available from companies such as Witco Corporation, Union Camp, Chemtall, and Emery Industries. The reaction products are available from, for example, Champion Technologies, Inc., and Witco Corporation. Additional compounds that may be used as tackifying agents include liquids and solutions of, for example, polyesters, polycarbonates and polycarbamates, natural resins such as shellac, and the like. Suitable tackifying agents are described in U.S. Patent Number 5,853,048 issued to Weaver, *et al.*, and U.S. Patent Number 5,833,000 issued to Weaver, *et al.*, the relevant disclosures of which are herein incorporated by reference.

Tackifying agents suitable for use in the present invention may be either used such that they form non-hardening coating or they may be combined with a multifunctional material capable of reacting with the tackifying compound to form a hardened coating. A "hardened coating" as used herein means that the reaction of the tackifying compound with the multifunctional material will result in a substantially non-flowable reaction product that exhibits a higher compressive strength in a consolidated agglomerate than the tackifying compound alone with the particulates. In this instance, the tackifying agent may function similarly to a hardenable resin. Multifunctional materials suitable for use in the present invention include, but are not limited to, aldehydes such as formaldehyde, dialdehydes such as glutaraldehyde, hemiacetals or aldehyde-releasing compounds, diacid halides, dihalides such as dichlorides and dibromides, polyacid anhydrides such as citric acid, epoxides, furfuraldehyde, glutaraldehyde or aldehyde condensates and the like, and combinations thereof. In some embodiments of the present invention, the multifunctional material may be mixed with the tackifying compound in an amount of from about 0.01% to about 50% by weight of the tackifying compound to effect formation of the reaction product. In some preferable embodiments, the compound is present in an amount of from about 0.5% to about 1% by weight of the tackifying compound. Suitable multifunctional materials are described in U.S. Patent Number 5,839,510 issued to Weaver, *et al.*, the relevant disclosure of which is herein incorporated by reference.

The tackifying agent may act, *inter alia*, to enhance the grain-grain contact between individual particulates. Moreover, the tackifying agent may soften any previously-applied, partially cured resin on the particulates. This dual action of the tackifying agent may improve the final consolidation strength of a particulate pack made in accordance with the present invention.

Any servicing fluid suitable for a subterranean application may be used in accordance with the teachings of the present invention, including aqueous gels, emulsions, and other suitable fracturing fluids. Suitable aqueous gels are generally comprised of water and one or more gelling agents. Suitable emulsions may be invert or regular and may be comprised of two immiscible liquids such as an aqueous gelled liquid and a liquefied, normally gaseous fluid, such as nitrogen. In certain exemplary embodiments of the present invention, the servicing fluids are aqueous gels comprised of water, a gelling agent for gelling the water and increasing its viscosity, and, optionally, a cross-linking agent for cross-linking the gel and further increasing the viscosity of the fluid. The increased viscosity of the gelled, or gelled and cross-linked, fracturing fluid, *inter alia*, reduces fluid loss and allows the fracturing fluid to transport significant quantities of suspended proppant particles.

To facilitate a better understanding of the present invention, the following examples of preferred embodiments are given. In no way should the following examples be read to limit or define the scope of the invention.

EXAMPLES

Example 1

Four 250-gram samples of 20/40-mesh size bauxite proppant were coated with a total of 7.8 cc of high-temperature epoxy resin. The samples were coated such that in each sample a different portion of the sample was coated with the resin (*e.g.*, 100%, 75%, 50%, and 25%). Each resin-coated proppant sample was then poured into a cross-linking gel carrier fluid while the fluid was stirred at high speed using an overhead stirrer. After 10 seconds of high speed stirring, the proppant slurries were stirred at very low speed to stimulate the effect of pumping and suspending the proppant slurries in fractures during hydraulic fracturing treatments. Each proppant slurry was then poured into a brass chamber, packed, and cured at 325 °F for 20 hours. After curing, the consolidated cores were obtained, cut into size, and unconfined compressive strengths were determined for each sample composition. These unconfined compressive strengths are shown in Table 1, in which:

- sample composition No. 1 contains 250 grams of proppant coated with a total of 7.8 cc of resin;
- sample composition No. 2 contains 250 grams of proppant, 188 grams of which were coated with a total of 7.8 cc of resin;
- sample composition No. 3 contains 250 grams of proppant, 125 grams of which were coated with a total of 7.8 cc of resin; and
- sample composition No. 4 contains 250 grams of proppant, 62 grams of which were coated with a total of 7.8 cc of resin.

TABLE 1

Proppant	Unconfined Compressive Strength (psi)
Sample Composition No. 1	480
Sample Composition No. 2	565
Sample Composition No. 3	580
Sample Composition No. 4	545

From Table 1, it is evident that the unconfined compressive strengths of the sample compositions were higher when only a portion of the sample had been coated with resin.

Therefore, the present invention is well adapted to attain the ends and advantages mentioned as well as those that are inherent therein. While numerous changes may be made by those skilled in the art, such changes are encompassed within the spirit of this invention as defined by the appended claims.

What is claimed is:

1. A method of consolidating particulates comprising:

providing a slurry comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with resin and wherein the second portion of particulates is substantially free of resin;

introducing the slurry into a portion of a subterranean formation such that the first portion of particulates and second portion of particulates form a particulate pack in the portion of the subterranean formation; and,

allowing the resin to substantially consolidate the particulate pack.

2. The method of claim 1, wherein the portion of a subterranean formation comprises a portion of a fracture or a portion of the annulus surrounding a well bore.

3. The method of claim 1, wherein the resin comprises at least one component chosen from an epoxy-based resin, a novolak resin, a polyepoxide resin, a phenol-aldehyde resin, a urea-aldehyde resin, a urethane resin, a phenolic resin, a furan/furfuryl alcohol resin, a phenolic/latex resin, a phenol formaldehyde resin, a polyester resin, a polyurethane resin, an acrylate resin, and a combination thereof.

4. The method of claim 1, wherein the first portion of particulates comprises between about 10% and about 60%, by weight of the combined weight of the first and second portions of particulates.

5. The method of claim 1, wherein the resin is present in an amount in the range of from about 5% to about 50% by weight of the first portion of particulates.

6. The method of claim 1, wherein the resin comprises a curable resin.

7. The method of claim 1, wherein the resin comprises a non-curable resin.

8. The method of claim 1, wherein the first portion of particulates is at least partially coated with a tackifying agent.

9. The method of claim 8, wherein the tackifying agent is present in an amount in the range of from about 2% to about 7% by weight of the first portion of particulates.

10. The method of claim 8, wherein the tackifying agent comprises at least one component chosen from a polyamide, a polyester, a polycarbonate, a polycarbamate, a natural resin, and a combination thereof.

11. The method of claim 8, wherein the first portion of the particulates is at least partially coated with a multifunctional material.

12. The method of claim 11, wherein the multifunctional material comprises at least one component chosen from an aldehyde, a hemiacetal, an aldehyde-releasing compound, a diacid halide, a dihalide, a polyacid anhydride, an epoxide, a furfuraldehyde, a glutaraldehyde, an aldehyde condensate, and a combination thereof.

13. The method of claim 11, wherein the multifunctional material is present in an amount in the range of from about 0.01% to about 50% by weight of the tackifying agent.

14. The method of claim 11, wherein the multifunctional material is present in an amount in the range of from about 0.1% to about 1% by weight of the tackifying agent.

15. The method of claim 1, wherein the second portion of particulates is at least partially coated with an activator.

16. The method of claim 15, wherein the activator is present in an amount in the range of from about 0.01% to about 25% by weight of the second portion of particulates.

17. The method of claim 15, wherein the activator comprises at least one component chosen from an alcohol; a ketone; an ester; an ether; an amide; benzene sulfonic acid; sulfuric acid; methane sulfonic acid; trichloroacetic acid; hydrochloric acid; hydrofluoric acid; ferric chloride; toluene sulfonic acid; chlorobenzene sulfonic acid; nitric acid; perchloric acid; a water soluble multivalent metal salt catalyst comprising at least one multivalent ion of either manganese, zinc, cadmium, magnesium, cobalt, nickel, copper, tin, iron, lead, or calcium; and a combination thereof.

18. The method of claim 1, wherein the second portion of particulates is at least partially coated with an curing agent.

19. The method of claim 18, wherein the curing agent is present in an amount in the range of from about 0.01% to about 25% by weight of the second portion of particulates.

20. The method of claim 18, wherein the curing agent comprises at least one component chosen from an amine, a polyamine, an amide, a polyamide, hexachloroacetone, 1,1,3-trichlorotrifluoroacetone, benzotrichloride, benzylchloride, benzalchloride, 4,4'-diaminodiphenyl sulfone, and a combination thereof.

21. A method of consolidating particulates comprising:

providing a slurry comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with tackifying agent and wherein the second portion of particulates is substantially free of tackifying agent;

introducing the slurry into a portion of a subterranean formation such that the first portion of particulates and second portion of particulates form a particulate pack in the portion of the subterranean formation; and,

allowing the tackifying agent to substantially consolidate the particulate pack.

22. The method of claim 21, wherein the portion of a subterranean formation comprises a portion of a fracture or a portion of the annulus surrounding a well bore.

23. The method of claim 21, wherein the first portion of particulates comprises between about 10% and about 60%, by weight, of the combined weight of the first and second portions of particulates.

24. The method of claim 21, wherein the tackifying agent is present in an amount in the range of about 5% to about 10% by weight of the first portion of particulates.

25. The method of claim 21, wherein the tackifying agent comprises at least one component chosen from a polyamide, polyester, polycarbonate, polycarbamate, a natural resin, and a combination thereof.

26. The method of claim 21, wherein the first portion of particulates is at least partially coated with a multifunctional material.

27. The method of claim 26, wherein the multifunctional material comprises at least one component chosen from an aldehyde, a hemiacetal, an aldehyde-releasing compound, a diacid halide, a dihalide, a polyacid anhydride, an epoxide, a furfuraldehyde, a glutaraldehyde, an aldehyde condensate, and a combination thereof

28. The method of claim 26, wherein the multifunctional material is present in an amount in the range of from about 0.01% to about 50% by weight of the tackifying agent.

29. The method of claim 26, wherein the multifunctional material is present in an amount in the range of from about 0.1% to about 1% by weight of the tackifying agent.

30. A particulate slurry for use in subterranean formations comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with resin and wherein the second portion of particulates is substantially free of resin.

31. The particulate slurry of claim 30, wherein the resin comprises at least one component chosen from an epoxy-based resin, a novolak resin, a polyepoxide resin, a phenol-aldehyde resin, a urea-aldehyde resin, a urethane resin, a phenolic resin, a furan/furfuryl alcohol resin, a phenolic/latex resin, a phenol formaldehyde resin, a polyester resin, a polyurethane resin, an acrylate resin, and a combination thereof.

32. The particulate slurry of claim 30, wherein the first portion of particulates comprises between about 10% and about 60%, by weight of the combined weight of the first and second portions of particulates.

33. The particulate slurry of claim 30, wherein the resin is present in an amount in the range of about 5% to about 50% by weight of the first portion of particulates.

34. The particulate slurry of claim 30, wherein the resin comprises a curable resin.

35. The particulate slurry of claim 30, wherein the resin comprises a non-curable resin.

36. The particulate slurry of claim 30, wherein the first portion of particulates is at least partially coated with a tackifying agent.

37. The particulate slurry of claim 36, wherein the tackifying agent is present in an amount in the range of from about 2% to about 7% by weight of the first portion of particulates.

38. The particulate slurry of claim 36, wherein the tackifying agent comprises at least one component chosen from a polyamide, polyester, polycarbonate, polycarbamate, a natural resin, and a combination thereof.

39. The particulate slurry of claim 36, wherein the particulate slurry further comprises a multifunctional material.

40. The particulate slurry of claim 39, wherein the multifunctional material comprises at least one component chosen from an aldehyde, a hemiacetal, an aldehyde-releasing compound, a diacid halide, a dihalide, a polyacid anhydride, an epoxide, a furfuraldehyde, a glutaraldehyde, an aldehyde condensate, and a combination thereof.

41. The particulate slurry of claim 39, wherein the multifunctional material is present in an amount in the range of from about 0.01% to about 50% by weight of the tackifying agent.

42. The particulate slurry of claim 39, wherein the multifunctional material is present in an amount in the range of from about 0.1% to about 1% by weight of the tackifying agent.

43. The particulate slurry of claim 30, wherein the second portion of particulates is at least partially coated with an activator.

44. The particulate slurry of claim 43, wherein the activator is present in an amount in the range of from about 0.01% to about 25% by weight of the second portion of particulates.

45. The particulate slurry of claim 43, wherein the activator comprises at least one component chosen from an alcohol; a ketone; an ester; an ether; an amide; benzene sulfonic acid; sulfuric acid; methane sulfonic acid; trichloroacetic acid; hydrochloric acid; hydrofluoric acid; ferric chloride; toluene sulfonic acid; chlorobenzene sulfonic acid; nitric acid; perchloric acid; a water soluble multivalent metal salt catalyst comprising at least one multivalent ion of either manganese, zinc, cadmium, magnesium, cobalt, nickel, copper, tin, iron, lead, or calcium; and a combination thereof.

46. The particulate slurry of claim 30, wherein the second portion of particulates is at least partially coated with a curing agent.

47. The particulate slurry of claim 46, wherein the curing agent is present in an amount in the range of from about 0.01% to about 25% by weight of the second portion of particulates.

48. The particulate slurry of claim 46, wherein the curing agent comprises at least one component chosen from an amine, a polyamine, an amide, a polyamide,

hexachloroacetone, 1,1,3-trichlorotrifluoroacetone, benzotrichloride, benzylchloride, benzalchloride, 4,4'-diaminodiphenyl sulfone, and a combination thereof.

49. A particulate slurry for use in subterranean formations comprising a carrier fluid, a first portion of particulates, and a second portion of particulates wherein the first portion of particulates is at least partially coated with tackifying agent and wherein the second portion of particulates is substantially free of tackifying agent.

50. The particulate slurry of claim 49, wherein the first portion of particulates comprises between about 10% and about 60%, by weight of the combined weight of the first and second portions of particulates.

51. The particulate slurry of claim 49, wherein the tackifying agent is present in an amount in the range of about 5% to about 10% by weight of the first portion of particulates.

52. The particulate slurry of claim 49, wherein the tackifying agent comprises at least one component chosen from a polyamide, a polyester, a polycarbonate, a polycarbamate, a natural resin, and a combination thereof.

53. The particulate slurry of claim 49, wherein the proppant slurry further comprises a multifunctional material.

54. The particulate slurry of claim 53, wherein the multifunctional material comprises at least one component chosen from an aldehyde, a hemiacetal, an aldehyde-releasing compound, a diacid halide, a dihalide, a polyacid anhydride, an epoxide, a furfuraldehyde, a glutaraldehyde, an aldehyde condensate, and a combination thereof.

55. The particulate slurry of claim 53, wherein the multifunctional material is present in an amount in the range of from about 0.01% to about 50% by weight of the tackifying agent.

56. The particulate slurry of claim 53, wherein the multifunctional material is present in an amount in the range of from about 0.1% to about 1% by weight of the tackifying agent.

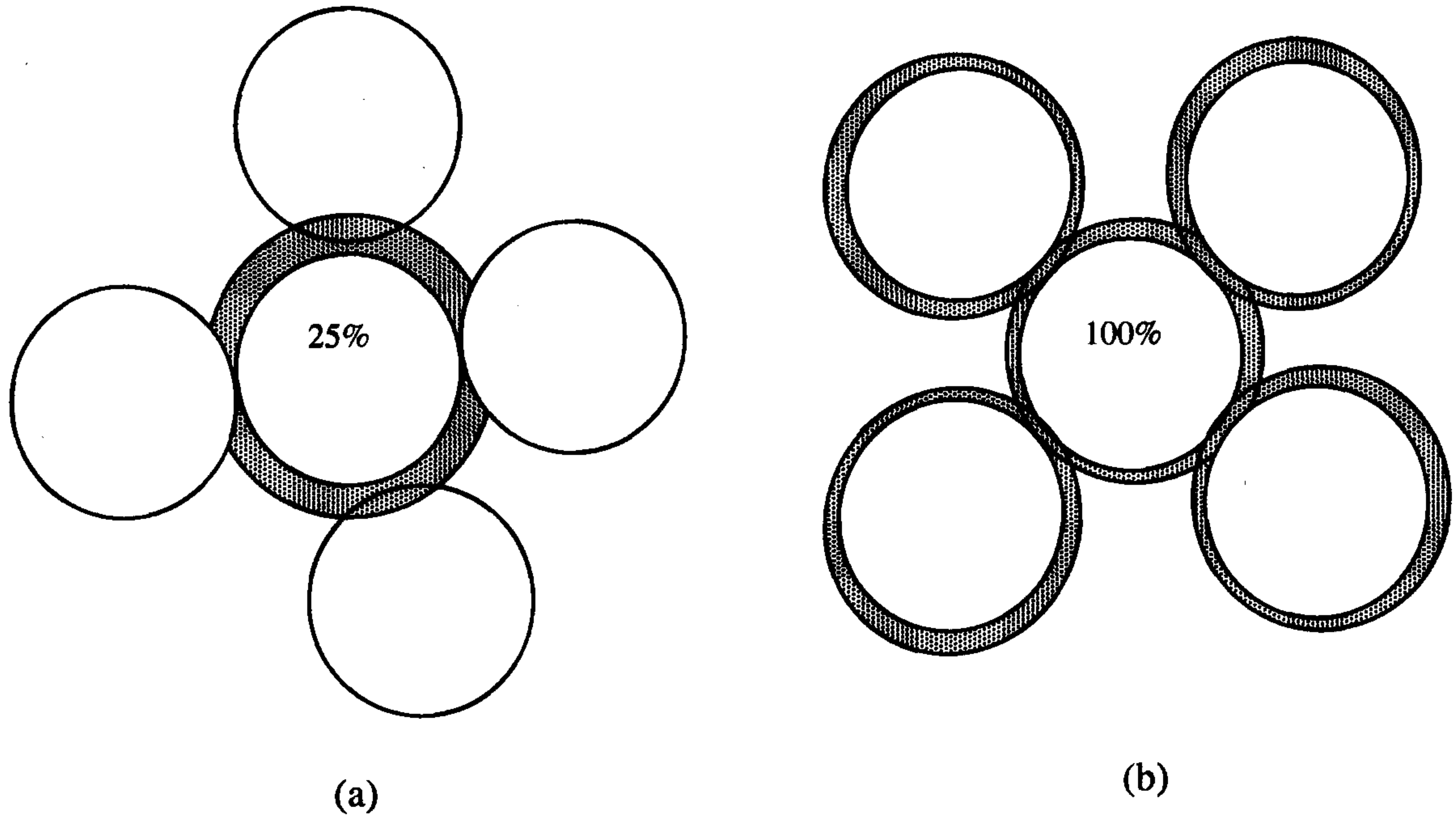
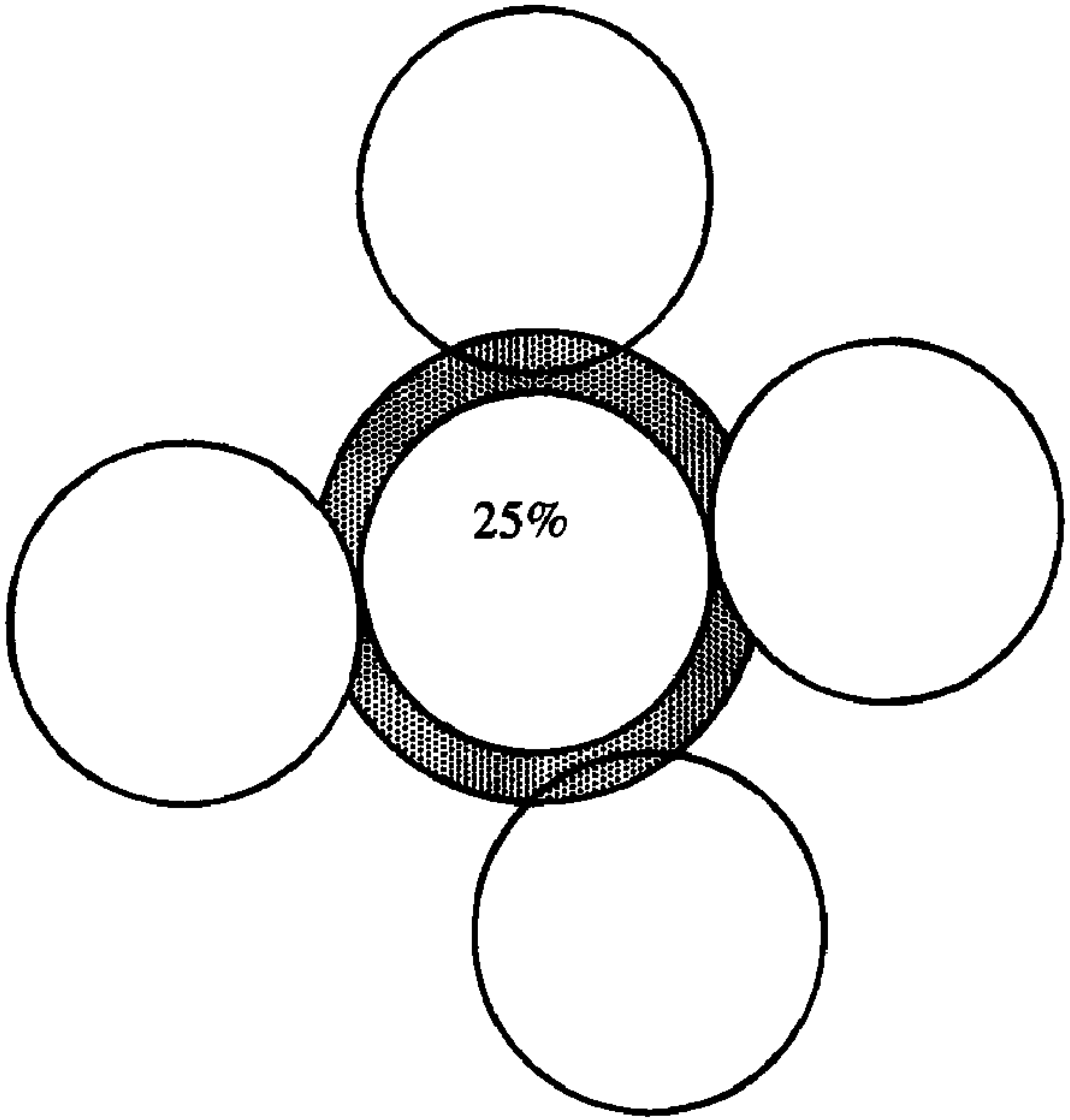
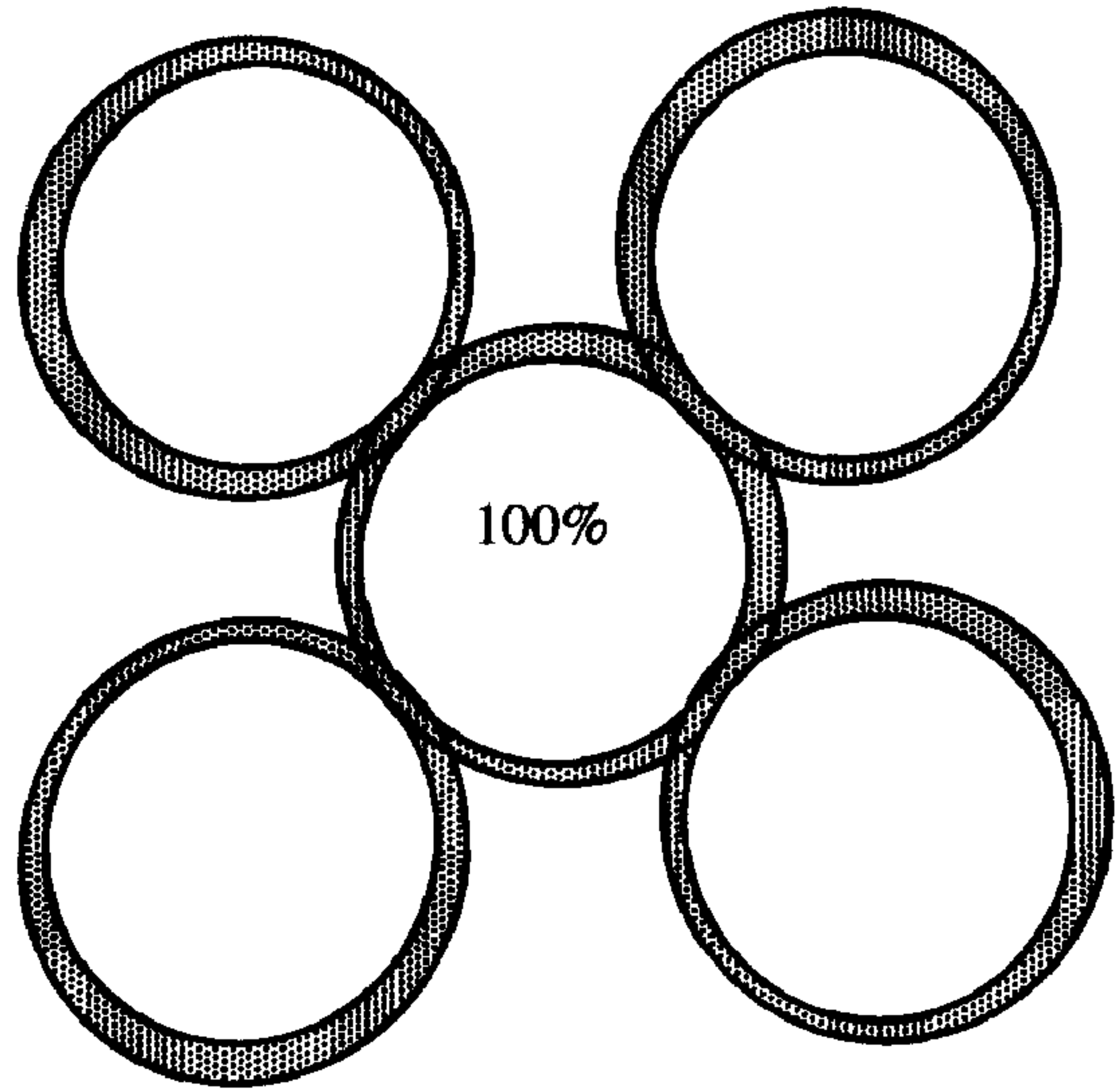


FIGURE 1



(a)



(b)