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PATENT SPECIFICATION

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(54) PROCESS FOR SOLIDIFYING TRENCH STABILIZING LIQUIDS

(71) We, KABUSHIKI KAISHA KUMAGAIGUMI, a Japanese Body Corporate, of 2-6-8 Chuo Fukui-shi Fukui-ken, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for solidifying a trench stabilizing liquid or slurry for use in preventing the crumbling of walls of a trench formed by excavating the ground.

Processes for forming a trench by excavating the ground, while supplying a stabilizing liquid therein, finds wide application at the present time. In this respect, the treatment of the stabilizing liquid has hitherto had recourse to a process which involves solidifying the stabilizing liquid, after bringing the stabilizing liquid out of a trench and replacing it with concrete by pouring the concrete into the trench. Also known is a process for solidifying the stabilizing liquid under the ground, the stabilizing liquid being left within the trench.

The processes for solidifying the stabilizing liquid outside the trench i.e. for separating the stabilizing liquid into a high moisture-content solid matter and water, include sedimentation processes employing a setting agent, vacuum dehydrating processes, pressure dehydrating processes, continuous granulating dehydrating processes, and processes involving the use of a filter and a press. However, these processes pose public nuisance problems due to the effluent or waste water thus separated, and the problem of selecting a site for dumping the high moisture content solid matter, in addition to the problem of construction of large-scale treatment equipment for such waste.

On the other hand, included in the above-mentioned process for solidifying the stabilizing liquid within the trench are processes using a self-hardening stabilizing liquid which contains a hardening agent which has been added beforehand so as to solidify after a given lapse of time. However, this process suffers from drawbacks due to the time limitation imposed

on the process, such as the time interval between the insertion of precast concrete members into a trench and the excavating operation. In addition to this, the insertion of precast concrete members into a trench leads to the discharge out of the trench of self-hardening stabilizing liquid, in an amount corresponding to the volume of the pre-cast concrete members, followed by solidification after a given lapse of time. Consequently the stabilizing liquid can not be reused since it has solidified.

It is an object of the present invention to provide a process for solidifying a stabilizing liquid which avoids or mitigates shortcomings experienced with prior art processes of the types described.

According to the present invention, there is provided a process for solidifying a trench stabilizing liquid or slurry for use in preventing the crumbling of a wall of a trench which comprises the steps of: adding sodium silicate to said stabilizing liquid or slurry to form a liquid mixture, agitating and mixing the liquid mixture; adding cement to the liquid mixture of the stabilizing liquid or slurry and sodium silicate, and then agitating and mixing the cement-sodium silicate-stabilising liquid or slurry.

Preferably, the sodium silicate and cement are added in turn to the stabilizing liquid or slurry followed by mixing and agitation, so that the gelation takes place quickly and is followed by solidification to achieve the desired compressive strength and water-tightness of the solidified mass. As a result, matter solidified outside the trench may be directly used as reclamation soil or refilling soil, while the matter solidified within the trench may provide an underground wall e.g. of a basement or as a foundation which affords desired strength and water-tightness.

Embodiments of the present invention will now be described by way of example only in more detail in conjunction with the accompanying drawings.

Fig. 1 is a transverse cross-sectional view

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2 of a trench formed by excavating the ground, in which stabilizing liquid has been solidified and thus a wall thereof has been formed;

5 Fig. 2 is a transverse cross-sectional view of a trench formed by excavating the ground, in which stabilizing liquid has been solidified between the walls of the trench, reinforcement members having been inserted therein;

10 Fig. 3 is a transverse cross-sectional view of a trench formed by excavating the ground, in which a stabilizing liquid has been solidified between the walls of the trench, tubular members having been placed in the trench;

15 Fig. 4 is a longitudinal cross-sectional view of a trench, in which stabilizing liquid is being agitated and mixed due to injection of air;

20 Fig. 5 is a transverse cross-sectional view of the trench of Fig. 4;

25 Fig. 6 is a longitudinal cross-sectional view of a trench containing stabilizing liquid showing the circulation of the liquid produced by air injection;

30 Fig. 7 is a transverse cross-sectional view of the trench of Fig. 6; and

Fig. 8 and Fig. 9 are longitudinal and transverse cross sectional views of another embodiment, respectively, which are similar to those of Figs. 4 and 5.

Reference is firstly made to an embodiment of the present invention, in which stabilizing

liquid is removed from a trench and then solidified. The stabilizing liquid according to the process of the invention is stored in a suitable tank or reservoir (not shown) set on the ground and then sodium silicate is added thereto, followed by agitation and mixing. Then, cement is added to a liquid mixture of stabilizing liquid and sodium silicate, followed by agitation and mixing in a like manner. The agitation and mixing may be forcibly carried out manually, mechanically by using power, or by air agitation due to the injection of air, which will be described in more detail hereinafter. The above cement should preferably be ordinary type Portland cement or mixed Portland cement. In addition, at the time of addition of the cement, it is preferable to add as a setting control agent, as required, at least two or more of a ligninsulfonate, a hydroxycarboxylic acid salt, nitrohumic acid salts, and magnesium silicofluoride.

Table 1 shows Examples 1 to 4, in which sodium silicate and ordinary type Portland cement alone are used as hardening agent, and Examples 5 to 7, wherein nitrohumic acid salt is also used for solidifying the stabilizing liquid. The stabilizing liquid is a bentonite aqueous suspension which contains 5% by weight lime. The setting times achieved are also indicated.

TABLE 1

	Stabilizing liquid (l)	sodium silicate (kg)	cement (kg)	additive (kg)	setting time (minute)
1	1000	50	50	—	15
2	1000	100	50	—	20
3	1000	50	100	—	3
4	1000	50	150	—	2
5	1000	50	50	0.25	33
6	1000	50	100	0.25	22
7	1000	50	150	0.25	20

(Agitation is carried out by manual agitating).

In this case, it should be noted that, when sodium silicate and cement are added to the stabilizing liquid for solidifying the stabilizing liquid, followed by agitation and mixing; if the cement is added to the stabilizing liquid first, there tends to take place a sedimentation-separation phenomenon. If the sodium silicate and cement are added simultaneously, then hardening takes place instantaneously. For

these reasons, it is difficult to solidify the stabilizing liquid uniformly, if the above procedure is followed.

Thus, sodium silicate is added to the stabilizing liquid first, as has been described earlier, followed by agitation and mixing, and then the cement added thereto, followed by further agitation and mixing in a like manner.

If the amounts of sodium silicate and cement

(9)

added to the stabilizing liquid are too small, then the stabilizing liquid fails to set, or sets with an extremely reduced set strength. In actual practice, the amount of sodium silicate to be added to 1000 litres of stabilizing liquid is at least 20 kg, preferably at least 30 kg; while the amount of cement is at least 30 kg or preferably at least 50 kg.

5 An embodiment for solidifying a stabilizing liquid in a trench will now be described in conjunction with Figures 1 to 3. The addition, agitation and mixing of sodium silicate and cement with the stabilizing liquid in a trench are carried out in the same manner as that of the preceding embodiment. When the stabilizing liquid is solidified in a trench, a setting control agent such as ligninsulfonate, and a viscosity-adjusting agent such as bentonite or carboxy-methylcellulose (C.M.C.) are added, as required, followed by agitation and mixing.

10 Figure 1 shows a water-tight wall 12 which has been formed by excavating the ground, while preventing crumbling of the wall surface of a trench 10 thus formed, by use of the stabilizing liquid, and then solidifying the stabilizing liquid as aforesaid. Figure 2 shows an example, wherein precast concrete reinforcement members 14 for forming a con-

tinuous wall in the ground are inserted into the stabilizing liquid in the trench 10. Then the stabilizing liquid is solidified as aforesaid to form solidified layers 16 between which the precast concrete members are rigidly retained. Figure 3 shows an example wherein tubular members 18, 20 are embedded in the stabilizing liquid in the trench 10 formed in the ground, and then the stabilizing liquid is solidified as aforesaid to provide solidified layers 22, in which the tubular members 18, 20 are rigidly retained.

Stabilizing liquids which may be employed according to the present invention include: (A) bentonite slurry (5% bentonite; 0.1% C.M.C., 0.1% nitrohumic acid salt) and (B) calcium base slurry (5% bentonite, 0.3% C.M.C., 0.7% nitrohumic acid salt, 0.6% $\text{Ca}(\text{OH})_2$, 0.2% NaOH). In addition, ordinary type Portland cement is preferably used in the present invention. Employable as additives are (C) ligninsulfonic acid salt (25% aqueous solution). The percentages are expressed by weight herein. Table 2 shows the relationship among the ingredients given above, with regard to setting time and comparative strength.

TABLE 2

	stabilizing liquid (l)	sodium silicate (kg)	ordinary cement (kg)	additive (25% solution) (kg)	setting time (minute)	compressive strength (kg/cm ²) (7 days)	agitating method
1	(A) 1000	30	30	—	62.0	Gel	manual agitation
2	(A) 1000	40	40	—	35.0	0.1	ditto
3	(A) 1000	50	50	—	15.0	0.2	ditto
4	(B) 1000	50	70	—	8.0	0.5	air injection
5	(B) 1000	50	100	—	5.0	0.8	ditto
6	(B) 1000	50	120	—	3.0	1.2	manual agitation
7	(A) 1000	40	100	(C) 0.25	10.0	0.9	ditto
8	(A) 1000	50	100	(C) 0.25	10.0	1.3	air injection
9	(A) 1000	50	200	(C) 1.0	8.0	2.1	ditto
10	(A) 1000	60	200	(C) 1.0	8.0	3.0	ditto
11	(A) 1000	60	250	(C) 2.0	5.0	4.7	ditto

As has been described earlier, sodium silicate is first added to the stabilizing liquid, followed by agitation and mixing, so that the sodium silicate may be dispersed in the stabilizing liquid uniformly. Then cement is added to the liquid mixture thus prepared, followed by agitation and mixing, so that cement is dispersed in the liquid mixture uniformly. Thereafter solidification of the mixture of the stabilizing liquid, sodium silicate and cement occurs. Accordingly, the stabilizing liquid is solidified uniformly, thus providing a homogeneous solidified body having the desired water-tightness. In addition, the process according to the invention may avoid sedimentation-separation phenomena which are a shortcoming when cement alone is used as hardening agent. The process also minimizes the influence of materials contained in the ground, which become mixed with the stabilizing liquid upon excavation of the ground, thus allowing uniform solidification of the stabilizing liquid. Furthermore, the process according to the invention may reduce the amount of hardening agent used, as compared with other processes. Still furthermore, the hardening agent (i.e. sodium silicate, cement and optionally an additive) may be added to the stabilizing liquid so as to solidify the stabilizing liquid, at any time required, so that no time limitation need be imposed on the operation for forming the trench, as compared with the use of a self-hardening stabilizing liquid. Hence freedom from the public nuisance problem due to dumping of the self-hardening stabilizing liquid results. When cement is added to the liquid mixture of stabilizing liquid and sodium silicate, followed by agitation and mixing, the solidifying reaction proceeds quickly. The aforesaid solidification of the stabilizing liquid will not take place unless cement is added thereto, so that the stabilizing liquid or the aforesaid liquid mixture may be

re-used for excavation of the ground.

For improving the compressive strength and/or water tightness of the solidified stabilizing liquid which has been solidified with a hardening agent including sodium silicate and cement, outside or inside the trench, it is advantageous that the stabilizing liquid contains, for instance, a bentonite aqueous suspension and a powdered material having non-swelling properties or swelling properties less than those of bentonite. The material may be suspended in the bentonite slurry. The aforesaid powdered materials may include clay, diatomaceous earth and silica sand which afford a lower degree of swelling than bentonite. One or more of these powdered materials may be added to the bentonite slurry, before the bentonite slurry is supplied into the trench.

The powdered materials may be suspended in the bentonite slurry and, since they do not cause a hydrating reaction, the powdered materials will not impair the desired viscosity and wall-forming properties of the bentonite slurry used during excavation. The hardening agent, when added upon agitation and mixing, serves to extend the gelation time of the bentonite slurry, as well as serving as an aggregate of non-swelling or low swelling properties for bentonite particles maintained in a highly swollen state, at the time of the solidification of the slurry. The powdered materials aggregate improves the strength and water-tightness of the solidified matter, and reduces the degree of shrinkage during drying.

Table 3 shows the results of unconfined compression strength tests on a solidified body obtained seven days after adding the hardening agent to bentonite slurries A, B, C containing clay, diatomaceous earth, silica sand, respectively and then agitating and mixing the liquid mixture thus prepared; followed by solidification.

TABLE 3

Powdered material Content	A (Clay # 250)	B (Diatomaceous earth # 200)		(Silica sand # 200)
0%	1.0	1.0		1.0
1.0	1.04	1.11		1.09
3.0	1.12	1.30		1.33
6.0	1.26	1.55		1.50
10.0	1.48	2.01		1.89

unconfined compression strength: relative value content %hardening agent (g) in 100 cc of bentonite slurry

: Tyler mesh

(12)

As indicated by Table 3, when the aforesaid powdered material is mixed with respective bentonite slurries, there results an increase in compressive strength as compared with the case where the powdered material is not added. In addition, the compressive strength increases with increase in the powdered material content (weight percent). It was confirmed by the tests that the gelation time is not shortened by the inclusion of the powdered material, but rather extended. Also the degree of shrinkage during drying is reduced.

For improving the compressive strength and water-tightness of the solidified stabilizing liquid body, fibrous material having non-swelling properties and non-water-hardening properties may be added to the stabilizing liquid beforehand. Mineral materials such as rock wool or asbestos may be used as fibrous inorganic materials. One or more mineral materials may be added to the slurry so as to be uniformly dispersed therein, before supplying the stabilizing liquid, i.e., a bentonite slurry into the trench. Alternatively, after supplying the bentonite slurry into the trench, the aforesaid rock wool may be added to the bentonite slurry in the trench, prior to the addition of the hardening agent.

The aforesaid fibrous inorganic material may be suspended in the bentonite slurry and has non-hydraulic properties, so that there is no possibility of causing a hydrating reaction between the bentonite slurry and the fibrous material, so that the viscosity and wall-forming properties of the bentonite slurry required for an excavating slurry, may be retained.

At the time of the addition of the hardening agent, followed by agitation and mixing, the fibrous material serves to neutralize or prevent any extension of the gelation time of the bentonite slurry, and aids in the formation of rigid bonds between particles of the slurry; thereby increasing the strength and water-tightness of the solidified body and reducing the degree of shrinkage during drying.

Table 4 shows the results of unconfined compression strength tests on a solidified body obtained seven days after adding hardening agent to bentonite slurries A and B containing rock wool or asbestos, followed by agitation, mixing and solidification.

Table 4.

fibrous material content	A (rock wool)	B (asbestos)
0%	1.0	1.0
1%	1.22	1.03
2%	1.37	1.05
3%	1.52	1.07
5%	1.60	1.09

unconfined compression strength: relative value content %: hardening agent (g) in 100 cc of bentonite slurry

As is clear from Table 4, when the aforesaid fibrous inorganic material is mixed with the respective bentonite slurries, there results an increase in compressive strength as compared with the case where a fibrous material is not added. In addition, the strength increases with an increase in content of the fibrous material (weight percent).

The tests reveal that the addition of a fibrous inorganic material does not shorten the gelation time of the bentonite slurry but rather extends the gelation time, and that the degree of shrinkage during drying of the solidified body is reduced. It is of supreme importance that the solidified body forming a water-tight wall has high compressive strength, water-tightness and homogeneity.

For improving the compressive strength and water-tightness of the solidified body of stabilizing liquid, even more important than the addition of the aforesaid fibrous material is to mix the stabilizing liquid and hardening agent thoroughly.

As has been described earlier, according to the present invention the hardening agent is forcibly mixed and agitated with the stabilizing liquid, before solidifying the stabilizing liquid. The aforesaid agitation and mixing may be advantageously achieved by the injection of air into the mixture, thereby obtaining a homogeneous solidified body.

Figures 4 to 9 show examples of agitation and mixing of the stabilizing liquid and hardening agent by air injection or agitation, when the stabilizing liquid is solidified within a trench.

Referring to Figures 4 to 7, there is shown a trench 10 of a rectangular cross-section in a horizontal plane, which is formed by excavating the ground with an excavating machine, while supplying stabilizing liquid 24 into the trench being formed. Two or more air injecting pipes 28 having a plurality of air injecting perforations 26 are inserted in the stabilizing liquid 24 filled in the trench 10 at a given spacing in the longitudinal direction thereof. Respective air injection pipes 28 are positioned at a given spacing in the longitudinal direction of the trench 10 and connected to a connecting pipe 30 which in turn is connected to a pneumatic source 31. When compressed air is injected, through the respective air injection perforations 26 in the air injection pipes 28, into the stabilizing liquid, air bubbles are continuously produced in the stabilizing liquid. The ascending streams of air bubbles cause circulating streams of stabilizing liquid as shown by arrows A in Figures 6 and 7, and turbulences among the ascending air bubble streams, as shown by arrows B.

During the creation of the circulating streams and turbulences, sodium silicate 34 is charged into the stabilizing liquid 24 in the trench 10 from a hopper 32, so that the sodium silicate becomes mixed and agitated

with the stabilizing liquid due to the aforesaid
turbulences and circulating streams. Thereafter
cement is charged into the liquid mixture thus
prepared, also from the hopper 32, so that the
5 cement is mixed and agitated with the liquid
mixture due to the turbulences and circulating
streams. The air injection pipes 28 are drawn
upwards out of the liquid mixture, before the
gelation of stabilizing liquid due to the charg-
10 ing of cement commences. Then the stabilizing
liquid is solidified in a short time thereafter.
Upon completion of solidification of the stabi-
lizing liquid, a water-tight wall is formed
underground.

15 Referring to Figures 8 and 9, there is shown
a trench 10 which is formed by excavating the
ground with an excavating machine, while
supplying a stabilizing liquid 24 into the
trench being formed. Then, precast concrete
20 members 36 having two or more air injection
pipes 28' embedded therein are inserted into
the stabilizing liquid filled in the trench 10.
The air injection pipes 28' have air injection
perforations 26'. The top ends of air injection
25 pipes 28' are connected to a connecting
pipe 30 which in turn is connected to a pneu-
matic source 31. Then, compressed air is in-
jected or blown through the plurality of in-
jection perforations 26' open from the side
30 surfaces of the precast concrete member 36, so
that ascending air bubble streams may be pro-
duced in the stabilizing liquid as in the pre-
vious embodiment.

35 Then, sodium silicate and cement are
sequentially charged into the stabilizing liquid
24 to agitate and mix the same with the stabi-
lizing liquid 24 due to the circulating streams
and turbulences. In this respect, the supply of
air through the pipes is interrupted before the
40 gelation of stabilizing liquid due to the
supply of cement is under way; allowing the
solidification of stabilizing liquid in a quite
short time thereafter. A solidified wall is thus
formed on opposite sides of the precast con-
45 crete member.

The aforesaid embodiment relates to agi-
tation and mixing of the stabilizing liquid and
hardening agent. However, the air injection
or blowing may also be applied to (i) agitation
50 and mixing of stabilizing liquid with stabilizing
liquid-supplementary constituents such as a
mixture of bentonite, lime, nitrohumate, CMC,
sodium hydroxide, or ferro-chrome ligninsulfon-
ate and chromium humate, and (ii) agitation
55 and mixing of stabilizing liquid with other
given materials.

Ascending air bubble streams are created
due to air being injected through air injection
60 pipes 28 into the stabilizing liquid 24, while
there are produced circulating streams and
turbulences due to the ascending air bubble
streams. Thus, the stabilizing liquid and other
materials added thereto may be thoroughly
uniformly agitated and mixed for a short time,
65 thereby preventing sedimentation and separa-

tion. In addition, the injection or blowing of
air into the stabilizing liquid is interrupted
before the stabilizing liquid is gellated to such
an extent that air bubbles are trapped therein,
70 thereby precluding the possibility of air
bubbles being retained in the solid phase. The
air injection process permits the use of simple
equipment for quick, uniform agitation and
mixing, without being affected by the shape
75 and size of the cross-sectional configuration
and depth of the trench.

WHAT WE CLAIM IS:—

1. A process for solidifying a trench stabi-
lizing liquid or slurry for use in preventing
the crumbling of a wall of a trench, compris-
80 ing the steps of: adding sodium silicate to said
stabilizing liquid or slurry to form a liquid
mixture, agitating and mixing the liquid mix-
ture; adding cement to the liquid mixture of
said stabilizing liquid or slurry and sodium
85 silicate, and then agitating and mixing the
cement-sodium silicate-stabilising liquid or
slurry mixture.
2. A process according to Claim 1, where-
in said stabilizing liquid or slurry is provided
90 in a trench and is thereafter removed from
said trench before solidifying said stabilizing
liquid or slurry.
3. A process according to Claim 1, where-
in said stabilizing liquid is provided in a
95 trench and is retained in said trench during
solidification.
4. A process according to any one of Claims
1 to 3, wherein said stabilizing slurry is a
100 bentonite aqueous suspension.
5. A process according to any one of Claims
1 to 4, wherein said stabilizing liquid or slurry
contains a non-water-hardening powdered
material, said powdered material being sus-
105 pended in said stabilizing liquid or slurry and
not swelling therein or swelling less than ben-
tonite.
6. A process according to Claim 5, wherein
said powdered material is clay, diatomaceous
110 earth or silica sand.
7. A process according to any one of
Claims 1 to 4, wherein said stabilizing liquid
or slurry contains fibrous inorganic material
which does not swell in stabilising liquid or
115 swells less than bentonite.
8. A process according to Claim 7, wherein
said fibrous inorganic material is rock wool
or asbestos.
9. A process according to any preceding
Claim, wherein said process comprises the
120 further steps of: injecting or blowing air into
said stabilizing liquid or slurry; agitating and
mixing said stabilizing liquid or slurry with
said sodium silicate due to turbulences and
circulating streams of said stabilizing liquid or
125 slurry, which have been created by ascending
streams of a plurality of bubbles of air thus
injected; and agitating and mixing cement
with the liquid mixture of said stabilizing



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with the stabilizing liquid due to the aforesaid
turbulences and circulating streams. Thereafter
cement is charged into the liquid mixture thus
prepared, also from the hopper 32, so that the
5 cement is mixed and agitated with the liquid
mixture due to the turbulences and circulating
streams. The air injection pipes 28 are drawn
upwards out of the liquid mixture, before the
gelation of stabilizing liquid due to the charg-
10 ing of cement commences. Then the stabilizing
liquid is solidified in a short time thereafter.
Upon completion of solidification of the stabi-
lizing liquid, a water-tight wall is formed
underground.

15 Referring to Figures 8 and 9, there is shown
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the stabilizing liquid filled in the trench 10.
The air injection pipes 28' have air injection
perforations 26'. The top ends of air injec-
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matic source 31. Then, compressed air is in-
jected or blown through the plurality of in-
jection perforations 26' open from the side
30 surfaces of the precast concrete member 36, so
that ascending air bubble streams may be pro-
duced in the stabilizing liquid as in the pre-
vious embodiment.

Then, sodium silicate and cement are
35 sequentially charged into the stabilizing liquid
24 to agitate and mix the same with the stabi-
lizing liquid 24 due to the circulating streams
and turbulences. In this respect, the supply of
air through the pipes is interrupted before the
40 gelation of stabilizing liquid due to the
supply of cement is under way; allowing the
solidification of stabilizing liquid in a quite
short time thereafter. A solidified wall is thus
formed on opposite sides of the precast con-
45 crete member.

The aforesaid embodiment relates to agi-
tation and mixing of the stabilizing liquid and
hardening agent. However, the air injection
or blowing may also be applied to (i) agitation
50 and mixing of stabilizing liquid with stabilizing
liquid-supplementary constituents such as a
mixture of bentonite, lime, nitrohumate, CMC,
sodium hydroxide, or ferro-chrome ligninsulfo-
nate and chromium humate, and (ii) agitation
55 and mixing of stabilizing liquid with other
given materials.

Ascending air bubble streams are created
due to air being injected through air injection
pipes 28 into the stabilizing liquid 24, while
60 there are produced circulating streams and
turbulences due to the ascending air bubble
streams. Thus, the stabilizing liquid and other
materials added thereto may be thoroughly
uniformly agitated and mixed for a short time,
65 thereby preventing sedimentation and separa-

tion. In addition, the injection or blowing of
air into the stabilizing liquid is interrupted
before the stabilizing liquid is gellated to such
an extent that air bubbles are trapped therein,
thereby precluding the possibility of air
70 bubbles being retained in the solid phase. The
air injection process permits the use of simple
equipment for quick, uniform agitation and
mixing, without being affected by the shape
and size of the cross-sectional configuration 75
and depth of the trench.

WHAT WE CLAIM IS:—

1. A process for solidifying a trench stabi-
lizing liquid or slurry for use in preventing
the crumbling of a wall of a trench, compris- 80
ing the steps of: adding sodium silicate to said
stabilizing liquid or slurry to form a liquid
mixture, agitating and mixing the liquid mix-
ture; adding cement to the liquid mixture of
said stabilizing liquid or slurry and sodium 85
silicate, and then agitating and mixing the
cement-sodium silicate-stabilising liquid or
slurry mixture.
2. A process according to Claim 1, where-
in said stabilizing liquid or slurry is provided 90
in a trench and is thereafter removed from
said trench before solidifying said stabilizing
liquid or slurry.
3. A process according to Claim 1, where-
in said stabilizing liquid is provided in a 95
trench and is retained in said trench during
solidification.
4. A process according to any one of Claims
1 to 3, wherein said stabilizing slurry is a
bentonite aqueous suspension. 100
5. A process according to any one of Claims
1 to 4, wherein said stabilizing liquid or slurry
contains a non-water-hardening powdered
material, said powdered material being sus- 105
pended in said stabilizing liquid or slurry and
not swelling therein or swelling less than ben-
tonite.
6. A process according to Claim 5, wherein
said powdered material is clay, diatomaceous
earth or silica sand. 110
7. A process according to any one of
Claims 1 to 4, wherein said stabilizing liquid
or slurry contains fibrous inorganic material
which does not swell in stabilising liquid or
swells less than bentonite. 115
8. A process according to Claim 7, wherein
said fibrous inorganic material is rock wool
or asbestos.
9. A process according to any preceding
Claim, wherein said process comprises the 120
further steps of: injecting or blowing air into
said stabilizing liquid or slurry; agitating and
mixing said stabilizing liquid or slurry with
said sodium silicate due to turbulences and
circulating streams of said stabilizing liquid or
125 slurry, which have been created by ascending
streams of a plurality of bubbles of air thus
injected; and agitating and mixing cement
with the liquid mixture of said stabilizing

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liquid or slurry and said sodium silicate due to said turbulences and said circulating streams.

- 5 10. A process for solidifying a stabilising liquid or slurry for use in preventing the crumbling of walls of a trench substantially as herein described with reference to any Figure or Figures of the accompanying drawings.

11. A mass of stabilizing liquid or slurry solidified by the process of any preceding Claim. 10

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