Flood Grouting
Trenchless Pipe Repair

PG Pipe Grout Technical Information

Flood Grouting
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North America
14431 Ventura Blvd, #555
Sherman Oaks, CA 91423
Phone (888) 967-1820

floodgrouting.com
Trenchless Pipe Repair

Flood Grouting
Trenchless Pipe Repair

Our flood grouting method of pipe rehabilitation without excavation has been used successfully in Europe for more than 15 years. With our innovative rehabilitation system leaky sewer pipes, drain pipes and all kinds of low pressure pipes in all kinds of soil conditions can be resealed quickly, cleanly and economically.

We have been expanding in other countries in the European market and now we are making our system available in the United States.

We encourage you to contact us with any questions.

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PIPEGROUT and how it works

Environmentally friendly

The ingredients PG1 and PG2 used in the PIPEGROUT flooding system are environmentally neutral. PIPEGROUT PG1 is a specially formulated liquid with a high degree of viscosity.

Material stability and guarantee

PIPEGROUT is resistant to all kinds of acids and alkalis that can occur in sewer systems and is also resistant to biogenetic sulphuric acid. The conglomerate that is formed is similar to sandstone and does not shrink or expand after hardening. It does not dissolve, and remains in a stable in form.

How does it work?

The primary options available for the rehabilitation of pipes is the excavation and replacement of the damaged pipe section or lining the pipe with a sleeve. However, there is an alternative, the injection process. This process is used for sealing leaks in the region of the pipes, pipe joints and manholes, as well as lateral cracks.

Pipe rehabilitation is generally possible from 1 inch diameter up to 30 inches in diameter, but it is limited to the size of the delivery equipment.

Before starting the rehabilitation, the volume of the whole sector to be rehabilitated is calculated on the basis of existing plans and inspection results and the amount of PIPE GROUT required is estimated based on the type of damage and its extent or on the basis of a water leakage test.

In the first working step, the sector to be rehabilitated is taken out of service by inserting sealing balloons or sealing discs at the cleaning and inspection openings. Then the sector is cleaned.

The cleaning is carried out by a high pressure cleaning process and starts at the end manhole and high point of the collector and ends at the manhole of the main collector. The street runoffs and their connecting drains as well as the rainwater pipes are cleaned separately from the surface.

After the cleaning process has been completed and the sector to be rehabilitated has been sealed off at the manhole of the main collector, you need to start at the lowest part of the sector with the filling of the connected pipe system containing PIPEGROUT 1 (PG1). As long as the tanker possesses a correspondingly long filling hose, it can be placed at a distance of up to 150 ft from the manhole for this purpose, thus minimizing traffic disturbances.

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The filling process is strongly influenced by the exfiltration rate of the fluid. Therefore, when the filling process has reached the crown of the pipe or a height of 2 ft above pipe invert, the filling process is interrupted for approx. 3 min. in order to judge the loss of fluid.

If there is little loss of fluid, then the filling process is continued as follows:

Fill the PG1 up to the top level of the manhole. The lowering of the fluid level is measured by instruments and recorded. After about 30 minutes, the injection medium loss is filled up again to the top of the manhole by renewed filling. The hydrostatic pressure forces the injection medium into the leaks or through it into the ground. The PG1 injection medium is left in the sector to be rehabilitated for approx. 45 minutes before it is removed by vacuum pumps.

The sector to be rehabilitated is flushed out with water at a low pressure after each filling process in order to prevent deposits of the injection medium at the sewer walls and especially in the region of the invert. The pipes that cannot be cleaned with the HP process are flushed out with a hose from the surface.

In the second filling process, the sector is filled with PG2 injection medium in the same manner as with PG1 to the top of the manhole. This component also remains in the sector to be rehabilitated for approx. 45 minutes. There it reacts with the PIPEGROUT 1 adhering to the embedment in the ground material and combines to form an irreversible watertight conglomerate.

When the sinking of the fluid level comes to a stop, the PG2 is filled once more up to the top. If no further lowering of the level is observed, then the sector to be rehabilitated is leak tight, i.e. it has been successfully repaired. The PG2 is pumped out and the rehabilitated sector is flushed out again.

If after 45 minutes of effective time, a lowering of the fluid level can still be observed, then all the working steps in the procedure are repeated until the sector to be rehabilitated is leak tight (the PG2 level remains stable).

After completion of the rehabilitation measures, the sector is cleaned and, after removal of all sealing balloons or discs, the sewer system can be taken into operation again.

During the execution of the rehabilitation measures, all results and observations are noted in the rehabilitation record.

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1 *Step 1: High pressure cleaning*

The cleaning is carried out by a high pressure cleaning process and starts at the end manhole and high point of the collector and ends at the manhole of the main collector. The street runoffs and their connecting drains as well as the rainwater pipes are cleaned separately from the surface.

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2 *Step 2: Video inspection*

A video inspection needs to be carried out to get an idea of the damage.

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3 *Step 3: Blocking the pipes*

The pipe blockers are necessary to block off the section of sewer pipe to be rehabilitated from the rest of the system. Because there will be pressure on the pipe blockers, it is important that the pipe blockers are mounted correctly so they can't slide out of their position. The first blocker has to be set on the deepest point of the system and the last on the highest.

The filling process should be started from the deepest point, a blocker with bypass has to be used.

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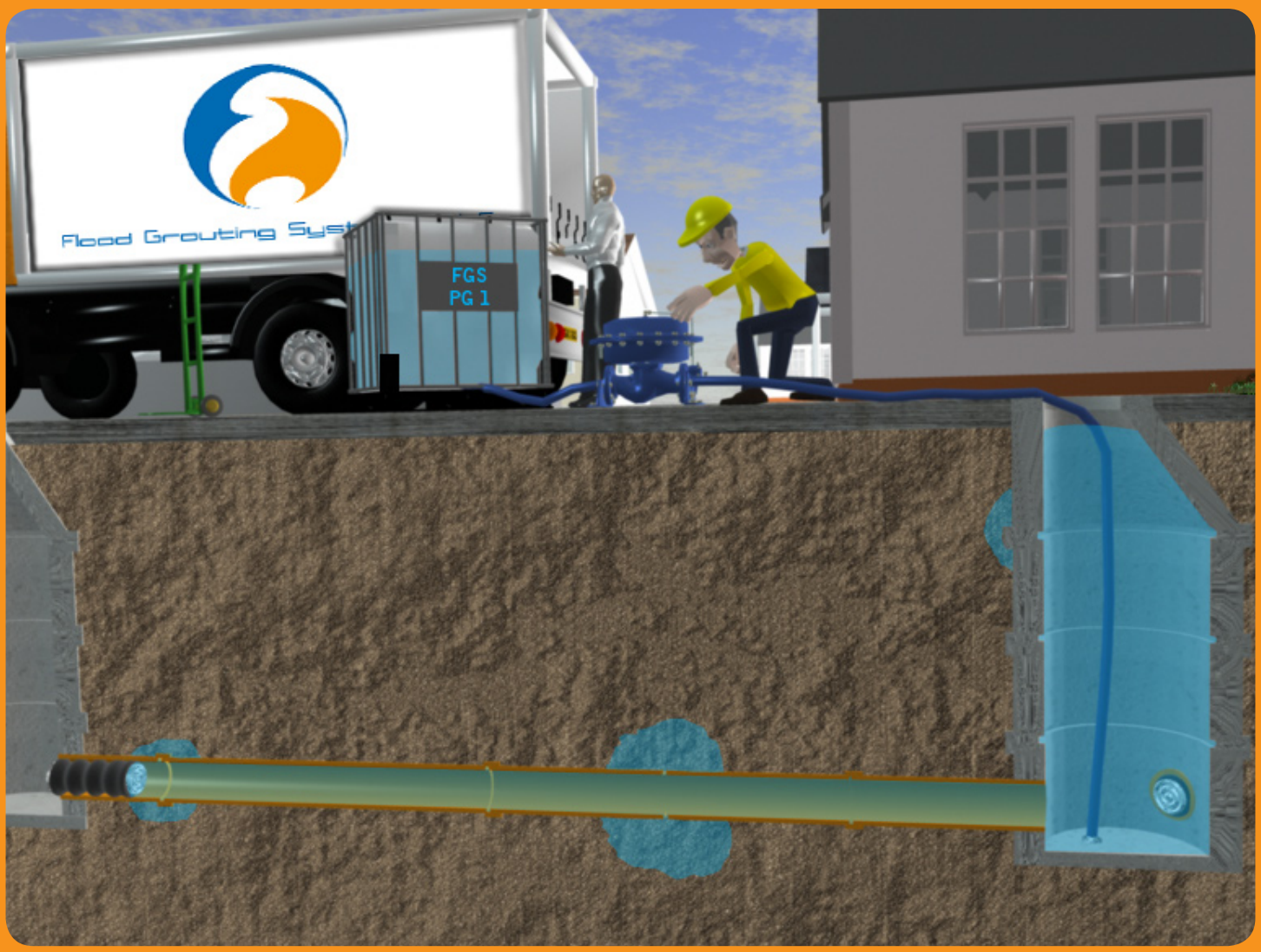
4 *Step 4: Filling in the renovation fluid PG1*



The filling process is strongly influenced by the exfiltration rate of the fluid. Therefore, when the filling process has reached the crown of the pipe or a height of 2 ft above pipe invert, the filling process is interrupted for approx. 3 min. in order to judge the loss of fluid.

Fill the PG1 up to the top level of the manhole. The lowering of the fluid level is measured by instruments and recorded. After about 30 minutes, the injection medium loss is topped up again to the top of the manhole by renewed filling. The hydrostatic pressure forces the injection medium into the leaks or through it into the ground. The PG1 injection medium is left in the sector to be rehabilitated for approx. 45 minutes before it is removed by vacuum pumps.

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5 *Step 5: Low pressure cleaning*

The sector to be rehabilitated is flushed out with water at low pressure after each filling process in order to prevent deposits of the injection medium at the sewer walls and especially in the region of the invert. The pipes that cannot be cleaned with the HP process are flushed out with a hose from the surface.

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6 *Step 6: Filling in the renovation fluid PG2*

In the second filling process, the sector is filled with PG2 injection medium in the same manner as with PG1 to the top of the manhole. This component also remains in the sector to be rehabilitated for approx. 45 minutes. There it reacts with the PIPEGROUT 1 adhering to the embedment in the ground material and combines to form an irreversible watertight conglomerate.

When the sinking of the fluid level comes to a stop, the PG2 is filled once more up to the top. If no further lowering of the level is observed, then the sector to be rehabilitated is leak tight, i.e. it has been successfully repaired. The PG2 is pumped out and the rehabilitated sector is flushed out again.

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7 *Step 7: One more low pressure cleaning*

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After completion of the rehabilitation measures, the sector is cleaned and, after removal of all sealing balloons or discs, the sewer system can be taken into operation again.

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Record of Rehabilitation with PG

Record of rehabiltitation with PG (sewer)

Flood Grouting Systems PG

Client		Date	
ZIP/City		Company	
Street		Foreman	
Site plan (sketch)			
Actual water loss:		Nominal water loss	<70% within 15min
If actual water loss is bigger, preliminary work required - performed **○** no **○** yes Date:			
Cleaning date:		Number Manholes:	
Type of soil:		Depth.:	ft
Pipe material:		Dia. Manhole:	ft
Pipe diameter:	in	Total volume:	ft3
Pipe length:	ft/yd		

	Rinse between cycles						Finishing flush		
	○ yes	○ no	○ yes	○ no	○ yes	○ no	○ yes	○ no	

1. Cycle				2. Cycle			
PG1 Fill. level		PG2 Fill. level		PG1 Fill. Level		PG2 Fill. level	
Time	Level	Time	Level	Time	Level	Time	Level

Nominal values:
Level: 3ft above the highest point of the pipe level
Time of influence of PG1 and PG2: maximum 45min
End of injection when filling level of PG2 remains at the same level for at least 45min

Time needed:	hours
PG1 used:	ft3
PG2 used:	ft3

Inner diameter of the hose used for the level measurement:

inch														
2														
4														
6														
8														
10														
12														
14														
16														
18														
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	5	10	15	20	25	30	35	40	45	50	55	60	65	70

Time (min)

Singnature foreman

MATERIAL SAFETY DATA SHEET

Date Issued: 11/16/2009

1. PRODUCT AND COMPANY INFORMATION

Product name: PG 1 Pipe Grout (Liquid)
Classification: Aqueous solution

Supplier:
Flood Grouting Systems, LLC
14431 Ventura Blvd, #555
Sherman Oaks, Ca 91423
Phone: (818) 985-3349
Fax: (818) 337-7524

EMERGENCY TELEPHONE NUMBER:
(818) 985-3349

2. COMPOSITION/INGREDIENT INFORMATION

Hazardous components
Silicic acid, sodium salt, mol ratio SiO2/Na2O >3,2 Concentration: < 40,00 %

CAS#: 1344-09-8
Classification: Xi; R36/37/38

3. HAZARDS IDENTIFICATION

Other information
The product does not need to be labelled in accordance with any directives or respective national laws.

Solutions of a molar ratio >=3,2 and concentration < 40 % are not classified as dangerous.

4. FIRST AID MEASURES

General advice: Remove from exposure, lie down. Take off all contaminated clothing immediately.
Inhalation: Move to fresh air. If symptoms persist, call a physician.
Skin contact: Wash off immediately with soap and plenty of water. If skin irritation persists, call a physician.
Eye contact: Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Ingestion: Clean mouth with water and drink afterwards plenty of water. Obtain medical attention.

5. FIRE AND EXPLOSION HAZARDS

Flash point: Not applicable. The product itself does not burn.
Flammable limits: The product itself does not burn.
Extinguishing media: Dry chemical, carbon dioxide, alcohol-resistant foam or water spray.
Protective equipment: Wear self-contained breathing apparatus and full protective clothing.
Special fire fighting precautions: Toxic fumes are released in fire situations.
Downwind personnel must be evacuated.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Use personal protective equipment. Avoid contact with skin and eyes. Danger of slipping if spilled
Environmental precautions: Local authorities should be advised if significant spillages cannot be contained.
Methods for cleaning up: Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders). Flush with plenty of water.

7. HANDLING AND STORAGE

Handling
Advice on safe handling : Keep container tightly closed. Handle and open container with care. Avoid formation of aerosol. The product itself is not flammable.

Storage
Store in cool place. Store in original container. Suitable materials for containers: Stainless steel, Mild steel. Unsuitable materials for containers: Aluminium, Zinc, glass, ceramics

Keep away from food, drink and animal feedingstuffs. Do not store near acids.

Protect from frost. Keep away from direct sunlight. Keep away from heat.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

ENGINEERING CONTROLS
Refer to protective measures listed in sections 7 and 8.

PERSONAL PROTECTIVE EQUIPMENT
Eyes and face: Wear chemical goggles and/or face shield to avoid splashing on face.
Body protection: Wear suitable protective clothing. impervious clothing
Respiratory protection: Required if vapours or aerosol are released. In case of insufficient ventilation, wear suitable respiratory equipment. Particle filter:P2
Hygiene measures: Take off all contaminated clothing immediately. Avoid contact with the skin and the eyes. Keep away from food, drink and animal feedingstuffs. Smoking, eating and drinking should be prohibited in the application area. Wash hands before breaks and at the end of workday.
Hand protection: Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. Also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion, and the contact time.
Protective gloves should be replaced at first signs of wear.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form: liquid
Colour: colourless
Odour: odourless

Safety data

Boiling point/boiling range: ca. 100 °C
Flash point: not applicable
Explosive properties: Product is not explosive.
Density: 1,37 g/cm3; 20 °C
Water solubility: soluble
pH: 12; 20 °C; (undiluted)

10. STABILITY AND REACTIVITY

Conditions to avoid: Extremes of temperature and direct sunlight. Protect from frost.
Materials to avoid: Acids, Light metals, Zinc, Fluorine
Hazardous reactions: Gives off hydrogen by reaction with base metals (zinc, aluminium). Risk of explosion. Exothermic reaction with strong acids.

General advice: No decomposition if stored and applied as directed.

11. TOXICOLOGICAL INFORMATION

Ingestion: LD50 rat > 2.000 mg/kg
Skin contact: May have irritant effects.
Eye contact: Contact with eyes may cause irritation.
Sensitisation: No sensitizing effect known.

Further information: Other dangerous properties can not be excluded. Handle in accordance with good industrial hygiene and safety practice.

12. ECOLOGICAL INFORMATION

Elimination information (persistence and degradability)

Biodegradability: The methods for determining biodegradability are not applicable to inorganic substances.

Ecotoxicity effects

Toxicity to fish: LC50 > 100 mg/l
Toxicity to bacteria: Toxicity to bacteria EC50 > 100 mg/l

Further information on ecology

Additional information: Ecological injuries are not known or expected under normal use.

13. DISPOSAL CONSIDERATIONS

Dispose of in accordance with local, state, and federal regulations.

14. TRANSPORT INFORMATION

15. REGULATORY INFORMATION

Sara Title III:

Not listed

16. OTHER INFORMATION

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation and disposal and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Restricted to professional users. Attentior Avoid exposure - obtain special instructions before use.
This safety datasheet only contains information relating to safety and does not replace any product information or product specification.

MATERIAL SAFETY DATA SHEET

Flood Grouting Systems, LLC

Date Issued: 11/16/2009

1. PRODUCT AND COMPANY INFORMATION

Product name: PG 2 Pipe Grout (Liquid)
Classification: Mixture of substances listed below with nonhazardous additions.

Supplier:
Flood Grouting Systems, LLC
14431 Ventura Blvd. #555
Sherman Oaks, CA 91423
Phone: (818) 985-3349
Fax: (818) 337-7524

EMERGENCY TELEPHONE NUMBER:
(818) 985-3349

2. COMPOSITION/INGREDIENT INFORMATION

Hazardous components

ethyl (S)-2-hydroxypropionate	Concentration: >= 25,00 % - < 50,00 %
CAS#: 687-47-8	
Classification: R10 Xi; R37, R41	Nota C

3. HAZARDS IDENTIFICATION

Risk advice to man and the environment
Xi
R41 Risk of serious damage to eyes.

R37 Irritating to respiratory system.

4. FIRST AID MEASURES

General advice: Remove from exposure, lie down. Take off all contaminated clothing immediately. First aider needs to protect himself.
Inhalation: Move to fresh air. If symptoms persist, call a physician. In case of shortness of breath, give oxygen. If breathing is irregular or stopped, administer artificial respiration. If unconscious place in recovery position and seek medical advice.
Skin contact: Wash off immediately with soap and plenty of water. If skin irritation persists, call a physician.
Eye contact: Rinse thoroughly with plenty of water for at least 15 minutes Protect unharmed eye. Consult an eye specialist immediately.
Ingestion: Rinse the mouth and spit the fluids out. Immediately give large quantities of water to drink. Do NOT induce vomiting. Call a physician immediately.

Notes to physician
Symptoms : Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea. High concentration of vapours may cause irritation to eyes and respiratory system.

5. FIRE AND EXPLOSION HAZARDS

Flash point: Not applicable. The product itself does not burn.
Flammable limits: The product itself does not burn.
Extinguishing media: Dry chemical, carbon dioxide, alcohol-resistant foam or water spray.
Protective equipment: Wear self-contained breathing apparatus and full protective clothing.
Special fire fighting precautions: Toxic fumes are released in fire situations.
Downwind personnel must be evacuated.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Use personal protective equipment. Avoid contact with skin and eyes. Danger of slipping if spilled
Environmental precautions: Local authorities should be advised if significant spillages cannot be contained.
Methods for cleaning up: Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders). Flush with plenty of water.

7. HANDLING AND STORAGE

Handling
Advice on safe handling : Ensure adequate ventilation. Emergency eye wash fountains and emergency showers should be available in the immediate vicinity. Avoid formation of aerosol.

Storage
Store in cool place. Store in original container. Suitable materials for containers: Stainless steel, Mild steel. Unsuitable materials for containers: Aluminium, Zinc, glass, ceramics

Keep away from food, drink and animal feedingstuffs. Do not store near acids. Keep away from heat. Keep away from direct sunlight. Protect against light.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

ENGINEERING CONTROLS
Refer to protective measures listed in sections 7 and 8.

PERSONAL PROTECTIVE EQUIPMENT
Eyes and face: Wear chemical goggles and/or face shield to avoid splashing on face.
Body protection: Wear suitable protective clothing. Solvent resistant protective clothing.
Respiratory protection: Required if vapours or aerosol are released. In case of insufficient ventilation, wear suitable respiratory equipment. Particle filter:A-P2
Hygiene measures: Take off all contaminated clothing immediately. Avoid contact with the skin and the eyes. Do not breathe gas/fumes/vapour/spray. Keep away from food, drink and animal feeding stuffs. Smoking, eating and drinking should be prohibited in the application area.
Hand protection: Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. Also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion, and the contact time.
Protective gloves should be replaced at first signs of wear.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form: liquid
Colour: clear, transparent
Odour: characteristic

Safety data

Boiling point/boiling range: 89 - 100 °C
Flash point: not applicable
Explosive properties: Product is not explosive.
Density: 1,084 g/cm3; 20 °C
Water solubility: miscible
pH: 4.25; 20 °C; (undiluted)

10. STABILITY AND REACTIVITY

Conditions to avoid: Direct heat. Strong sunlight for prolonged periods. Protect from frost.
Materials to avoid: Oxidizing agents
Hazardous reactions: Exothermic reaction with: Oxidizing agents Vapors may produce explosive mixtures with air at temperatures over the flame point.

General advice: No decomposition if stored and applied as directed.

11. TOXICOLOGICAL INFORMATION

Ingestion: ethyl (S)-2-hydroxypropionate: LD50 rat > 2.000 mg/kg OECD Test Guideline 401; ethyl (S)-2-hydroxypropionate: LD50 mouse 2.500 mg/kg
Inhalation: ethyl (S)-2-hydroxypropionate: LD50 rat 5,4 mg/l 4 h
Skin contact: May have irritant effects.
Eye contact: Irritating to eyes. Risk of serious damage to eyes.
Sensitisation: No sensitizing effect known.
Further information: Inhalation of high vapour concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting. Other dangerous properties can not be excluded. Handle in accordance with good industrial hygiene and safety practice.

12. ECOLOGICAL INFORMATION

Elimination information (persistence and degradability)

Biodegradability: ethyl (S)-2-hydroxypropionate: 86 % 28 d; Readily biodegradable.
Bioaccumulation: ethyl (S)-2-hydroxypropionate: Bioaccumulation is not expected.
Toxicity to fish: ethyl (S)-2-hydroxypropionate: LC50 Brachydanio rerio 320 mg/l 96 h OECD Test Guideline 203
Toxicity to daphnia: ethyl (S)-2-hydroxypropionate:EC50 Daphnia magna 683 mg/l 48 h OECD Test Guideline 202;
Toxicity to algae: ethyl (S)-2-hydroxypropionate: IC50 Pseudokirchneriella subcapitata 2,200 mg/l 70 h OECD Test Guideline 201;

Further information on ecology
Additional information: Ecological injuries are not known or expected under normal use.

13. DISPOSAL CONSIDERATIONS

Dispose of in accordance with local, state, and federal regulations.

14. TRANSPORT INFORMATION

15. REGULATORY INFORMATION

Sara Title III:

Not listed

16. OTHER INFORMATION

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation and disposal and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Restricted to professional users. Attentior Avoid exposure - obtain special instructions before use.
This safety datasheet only contains information relating to safety and does not replace any product information or product specification.

For the renovation of sewer pipes with PG by Flood Grouting Systems

This procedures manual describes the renovation of sewer pipes utilizing the PG two component Flood Grouting System.

Rehabilitation of sewer pipes

A renovation with PG Flood Grouting is necessary if sewer pipes or manholes are leaking. The application of PG grout can be used for all kinds of pipes including clay, concrete, PVC, ABS and cast iron. A test for leakage is done by means of a compression test or a water level test. When soil and or water is leaking into the pipe a camera inspection gives information about where it drains in and therefore where the damage is.

The cause for leakage can be breaks in the tubing, missing sealing gaskets in the sockets or broken splices. Further details about the damage can be obtained with a camera inspection; this does not necessarily need to be conducted before the PG is used to make a repair. A compression test with a leakage measurement can give you a good idea about the actual water loss.

Prior to use the PG fluids should be tested for the following measurements:

PG1 Density 1.30-1.40 g/cm3
1. Pour PG1 into a measuring cylinder
2. Dip the hydrometer into the fluid and let go so that it floats in the fluid. (Note that it's at the right temperature)
3. The result can be read at the liquid level and should be logged.
4. Clean the hydrometer with clear water.

PG2 ph-Value 1.8-3.5
1. Switch the indicator "Combi 3" to ph-value and dip the probe into the fluid.
2. Read the result and temperature from the display and log it.
3. Clean the probe with clear water.

PG2 conductivity 0.25-3.0 mS/cm
1. Switch the indicator "Combi 3" to mS while the probe is in PG2.
2. Read the result from the display and log it.
3. Clean the probe with clear water.

For a reaction test a plastic can is filled with PG1 and another one with PG2 up to a height of 1cm. Afterwards the same amount of water as PG components are filled into the two cans. The PG mixtures are stirred well. Then the contents of both cans, which are now filled with 1" of fluids, are boldly poured together into a third can.

In less than 60 seconds a firm, evenly solid body must have formed that can be toppled out of the can and will retain its form.

Documents: inventory list of rehabilitation fluids, test records PG

Start of Work

Inspection of the rehabilitation fluids PG1 and PG2 should be conducted at every second construction site. It should be inspected and logged as to how much fluid and in what condition the available is, so that it can be filled up before start of work if necessary.

Renovation Documents

The employees need to have the following documents while performing a renovation:

- Delivery note with client's address and invoice address
- Maps of the sewer system if required
- Special details of the sewer system e.g. if the soil or water drains in, type of soil conditions
- Parking allowance in public traffic
- Forms "construction site journal", "renovation protocol" and "test record" for the components

Renovation of leaking sewer pipes

After arriving at the customer's address the client or manager needs to be contacted to discuss how and when the renovation is to be executed and the scope of what is to taken care of.
Securing the construction site

The site must be secured in any case, that also applies if the renovation takes place in non-public areas. Suitable measures need to be taken so that no one accidentally trips over the tubes or falls down a manhole or shaft.

Preliminary Measures

After securing the construction site you need to verify by means of inspected that the maps provided match the real renovation area. Special attention needs to be given concerning the branches of in- and outflows.
A proper cleaning has to be executed. Cleaning with high pressure has to be done again if necessary.
Executing a PG renovation

Blocking the pipes

The pipe blockers are necessary to block off the section of sewer pipe to be rehabilitated from the rest of the system. Because there will be serious pressure on the pipe blockers, it has to be ensured that the pipe blockers are mounted correctly so they can't slide out of their position. Never use defective blockers!
The first blocker has to be set on the deepest point of the system and the last on the highest.
Due to the fact that the filling process should be started from the deepest point, a blocker with a bypass has to be used.

Filling in the renovation fluid

The pipe renovation fluids should always be filled in at the lowest point of the sewer system. Filling the sewer section with the renovation fluids must be carried out under careful observation at the manhole that is used for filling.

If the liquid level is decreasing fast it must be vacuumed out immediately. This might for example become

necessary if one of the pipe blockers starts leaking and a high fluid loss is impending. This is why during the filling-in process special attention must be paid to the position and air pressure of the pipe blockers.

If there are only small leakages, when e.g. the water loss test is only detecting a small permeability, the fluid PG 1 (and later the component PG 2) is immediately filled in up to the top edge of the manhole or 6 feet above the soffit. By doing this, it can be examined if and how fast the liquid level sinks. After filling the liquids up to 6 feet above the soffit the liquid level has to be recorded in the protocol correctly and over time. (see renovation protocol)

If bigger leakages are detected (loss more than 30% of the volume) preliminary work using the system PG-BLOC and PG-SEAL maybe necessary. This is a special Bentonite system that is brought into the renovation system to achieve a temporary sealing of the bigger leakages.

As soon as the Bentonite "is placed" in the system and no further loss occurs it is pumped out and after a short rinsing the actual PG cycle begins.

Changing the renovation fluid

The PG method is a dual component system. Therefore, the exchange of liquids in the sewer system is of special importance.

The liquids should not remain longer than 45 minutes in the pipe system before they are pumped out again. If high fluid losses appear it should be pumped out much sooner, sometimes after only a few minutes. After that PG-BLOC and PG-SEAL are employed.

After extraction by suction of the PG 1 component from the manhole the pipe blockers are opened slightly and the pipes are rinsed with low pressure to remove adherent PG 1 from the pipe.

Unless a dual circle system is used the filling hose for the liquids as well as the pump needs to be irrigated. The rinsing water can run off unhampered through the open pipe blockers. All moistened parts of the pipes need to be cleaned. After this is completed, the pipe system is again closed with the pipe blockers.

Before filling in the next component it is crucial to check the correct position and the right air pressure of the pipe blockers.

Completing of the renovation

The cycles are repeated (usually 1-3 times) until no liquid loss of the PG 2 component can be detected. This is the case when the system is filled up to 6 feet over the soffit and no lowering of the product level can be observed over the next 45 minutes. When this is achieved it is vacuumed out, the pipe blockers can be removed and after a short cleansing the pipe can continue its natural assignment.

Renovation protocol

All incidents and measurements at the construction site have to be recorded in the construction log. This log needs to include a sketch of the given factors of the location and all important information about the pipe system that is being renovated must be charted. The liquid levels are to be registered against the time. Every

single cycle has to be registered. The pipe is sealed when no lowering of the level of the renovation liquids can be detected after a period of 45 minutes.

Cleaning of the peripherals and suction hoses

After completing each renovation the staging area needs to be cleaned thoroughly. Removing all traces, especially of PG 1 is imperative, because once it dries it can only be removed with great effort. The construction site must be inspected prior to leaving to ensure that everything is clean and correct.