AV-202
Multigrout

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ANSI/NSF 61
DRINKING WATER SYSTEM COMPONENTS
88NN

AVANTI
Technical Manual

Introduction

AV-202 Multigrout is a chemical grout system of water-soluble hydrophilic polyurethane pre-polymers. Multigrout reacts freely with water to form a strong film, gel or foam according to the mix design requirements of the application. This capability makes Multigrout ideal for use as a remedial water stop in a wide range of construction applications.

The form of the final product, whether it is film, gel or foam, is controlled by the ratio of water to AV-202 Multigrout. For example, a mixture of 1 part Multigrout and from 1 to 5 parts water will produce a product with the general properties of a foam. A mixture of 1 part Multigrout and approximately 7 to 10 parts water will result in a resilient gel. A mixture of 1 part Multigrout and 16 to 20 parts water will result in a soft gel. Ratios of 1 part Multigrout and 25 to 30 parts water create a very soft gel. The specific physical properties of AV-202 Multigrout, when combined with water in various ratios, are depicted later in this manual.

As the ratio of water to Multigrout increases, the viscosity of the mixture decreases. The nature of a particular application dictates the proper ratio of Multigrout to water and experience is the best teacher for how to choose the correct mixture. An operator must always bear in mind that each application is unique and requires planning. The ideal goal should always be a balance between an initial product viscosity that makes placement effective and easy and a final product that will accomplish the job at hand.

An outstanding feature of AV-202 Multigrout is its adaptability to any of several water stop requirements. In an application needing a foam, for example, the product is appropriate as well as another application where a resilient gel is required. The property of the end product is easily controlled by any application program. Furthermore, AV-202 Multigrout can also be altered during a grouting program. For example, a quick foam can be formed initially and later “backed up” with a dense, strong gel, all from the same basic product. Complex grouting applications can often be simplified by the use of AV-202 Multigrout.

General Information

AV-202
Multigrout

Due to the adaptability of AV-202 Multigrout, the product is appropriate for many different waterproofing and sealing problems. It may be injected with a positive displacement pump or used with AV-219 (Oakum) for large cracks or joints and placed by hand. The ability to control the physical properties of the final product gives the applicator a tool for a wide variety of grouting programs. For injection placement, the best equipment is a positive displacement pump such as the Graco Airless Sprayer.

General Information continued.

For example, by combining Multigrout with water in a ratio of one part Multigrout and 1 to 5 parts of water, the resulting foam might be used to fill an abandoned pipeline. With a greater ratio of water to Multigrout, perhaps in the range of 1 part Multigrout to 10 parts of water, the product can be injected into a subsurface structure to seal cracks in concrete. By increasing the water ratio even higher to perhaps a 1 to 20 ratio of Multigrout to water, the resilient gel can be effectively used as an impermeable barrier for other applications.

AV-202 Multigrout is often used for grouting joints and repairing leaks in large sanitary and storm sewer pipes by forming a flexible gasket or plug in the flowing water path. In an uncured form, AV-202 is a viscous liquid similar in appearance to common honey. When mixed with a small amount of water, however, the grout expands and rapidly cures to a tough, flexible, cellular rubber that is essentially unaffected by sewer environments.

AV-202 Multigrout has a strong affinity for water. Although normally not required, standard static mixers may be used. Upon curing, the gel can contain many times its own volume of water. The mixture of AV-202 Multigrout and water is initially low in viscosity and can be injected under pressure to seal voids, fissures or cracks. Once the gel has cured, it is resistant to water, thus reducing permeability and forming an effective water shut off system. The cured grout also increases the strength of the soil mass and consolidates the soil.

When AV-202 Multigrout is mixed with a small amount of water, a reaction proceeds through two stages: foam stage and cure stage.

Both stages of the grout must be understood and controlled to obtain good results. The ambient temperature of the grout is the primary variable that affects foam and cure times.

Within 15 to 45 seconds after mixing, depending on mix ratios and the temperature of the grout and mix water, the material will begin to foam. The viscosity is such that the grout will not readily flow out of the point of placement, i.e., into the pipe or the soil outside of the pipe.

If unrestrained, the material may expand up to ten times the original unreacted volume of grout and water. Unrestrained expansion, however, results in a foam of low density. A compacted foam is more desirable for most applications and fillers or reinforcements such as oakum may be used to provide acceptable density.

Following the foam stage is the cure stage. During the cure stage, the grout solidifies and forms a cellular rubber gasket (reinforced by oakum if it has been added) which can withstand a water pressure test. After placement and the foam stage, the grout will continue to cure over the next several hours; however, within five to ten minutes it has achieved sufficient strength to form a serviceable water barrier.

Specific Description of AV-202 Multigrout

AV-202 Multigrout is a hydrophilic polymer. The uncured material is a caramel colored, translucent liquid with a viscosity in the 2500 centipoise range at 86°F. At workable water to polymer ratios, however, the viscosity can be adjusted to approach the 15 to 30 centipoise range. AV-202 contains non-volatile materials constituting almost 100% of its total weight.

When mixed with a specific quantity of water, the material can expand 10 to 12 times its original volume and cure to a tough, flexible and elastomeric condition. After completely curing, the AV-202 may exhibit strength properties of up to 80 psi tensile and 500% elongation.

Physical Properties of AV-202 Multigrout

The physical properties of monolithic films prepared with Multigrout are summarized as follows:

Table One:

Water : AV-202 Ratio	% AV-202*	Tensile Strength (kg/cm2)	Elongation (%)	Tear Strength (kg/cm2)
20:1	5%	120	100	15
10:1	10%	100	150	18
5:1	20%	46**	600	20

* Concentration by weight of Multigrout in the aqueous solution used to prepare a monolithic film.

** A foamy film is obtained when concentration is higher than 20%, i.e., less than five parts of water to one part of AV-202 Multigrout.

Chemical Properties

During the initial reaction stage of Multigrout with water, amines and carbon dioxide are generated by a reaction with water in the soil or water injected with the grout pump at the site of the leak to be sealed. Then, the resultant amines react quickly with an isocyanate group to form compounds with a three-dimensional structure cross-linked with urea and biuret linkages. These compounds form a gel which is insoluble in water.

Table Two:

Chemical Properties	
Flash Point	200°C
Corrosiveness	Non-corrosive
Reactivity	Reacts readily with water

Instructions for Using AV-202 Multigrout

Although the AV-202 Multigrout pre-polymer is a relatively thick material, it is easily handled with commercially available positive displacement pumps. AV-202 Multigrout is designed to cure with water, and may absorb large quantities into the reaction mass. The ratio of water to AV-202 Multigrout chosen depends upon the application. For most applications which require the use of gels, the water to AV-202 Multigrout ratio should be in the range of 10:1 to 15:1 by volume.

Higher ratios (i.e., greater than 15:1) give lower initial viscosities and longer gel times but reduce the unconfined compressive strength of the consolidated material in the grout zone. Such high ratios are primarily used for short-term erosion control of surface soils.

The initial mixed viscosity of the water to AV-202 Multigrout blend is important in determining the soils that can be penetrated and pumping pressure required. With the AV-202 Multigrout system, the initial mixed viscosity is dependent primarily on the water to AV-202 Multigrout ratio and water temperature.

The linearity of the rate at which the viscosity of the mixed grout increases from the time of mixing up to gelation is a second important factor in determining the degree and types of soil that can be penetrated. With the AV-202 Multigrout, the viscosity remains low for the initial 60 to 70% of the gel time and then increases rapidly as the blend approaches gelation.

The relationship between temperature and viscosity of AV-202 Multigrout pre-polymer (prior to mixture with water) is illustrated in Table Three.

Table Three:

Temperature		Viscosity
F°	C°	CPS
104	40	500
95	35	1000
86	30	2500
77	25	3500
68	20	5500
59	15	9000
50	10	14000

The relationship between the concentration of Multigrout (water/polymer ratio) and the properties of the resultant material is in Table Four.

Instructions continued.

Table Four:

Percentage Multigrout : Total Volume	Ratio Range Water : Multigrout	General Properties
50% to 20%	1:1 to 5:1	Foam
12% to 9%	7:1 to 10:1	Expansive Gel
6% to 5%	16:1 to 20:1	Soft Gel
4% to 3%	25:1 to 49:1	Very Weak Gel
2% to 1%	50:1 to 100:1	Emulsion

Gel time is defined as the time interval from initial mixing of AV-202 to the point where the blend viscosity is too high for gravity flow.

Gel time is controlled primarily by two factors:
1. Water temperature
2. Water : AV-202 ratio

Lower water temperatures and higher water to AV-202 ratios give longer gel and "tack free" times. Gel times may also vary slightly with the age of the AV-202 and chemical content of the water.

Table Five depicts the relationship between gel time and concentration of Multigrout with gel time measured at 3 levels of temperature in the aqueous solution.

Table Five:

Water : AV-202 Ratio	Temperature (°F)		
	68°	**80°**	**86°**
	Set Time in Minutes		
2:1	1.00	0.50	0.35
5:1	1.50	1.00	0.90
8:1	2.05	1.50	1.25
10:1	2.75	2.00	1.40
12:1	3.30	2.50	1.80
14:1	4.75	3.50	2.50
16:1	6.25	4.60	3.20
18:1	10.50	7.70	5.40
20:1	15.00	11.00	7.80

Table Six illustrates the relationship between foam time and concentration of Multigrout. Foam time was measured at 78° temperature in the aqueous solution. The foam requires approximately an equal amount of time to reach a tack free condition after its initial set.

Table Six:

AV-202 : Water Ratio	Foam Time in Minutes at 78°F
10:1	18.00
9:1	14.25
8:1	11.00
6:1	8.00
4:1	4.25
2:1	2.50
1:1	1.50

Data shows that the permeability of a soil grouted with AV-202 in gel form is a function of the extent that voids are filled with grout. Values in the 10-7 to 10-9 cm/sec range should be obtained when voids are essentially full of grout using the constant head permeability test method (ASTM D-2434).

Estimating AV-202 Application Requirements

AV-202 is designed to be used by qualified applicators with the proper equipment. Grouting equipment for the application of this product is available from Avanti International.

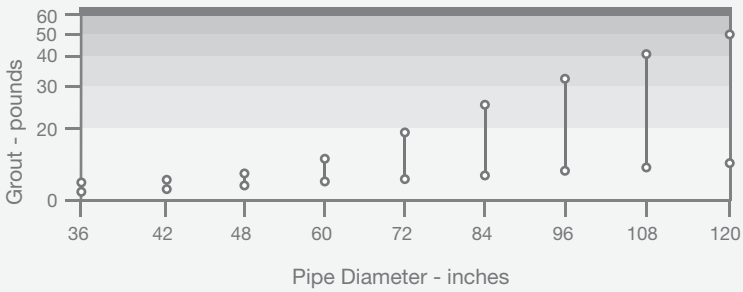

Figure 1: AV-202 Multigrout required for large diameter pipes.

Note: Refer to Avanti International's Large Diameter Pipe Sealing Specification – **available online at www.avantigrout.com.**

The quantities of AV-202 Multigrout required to rehabilitate or repair concrete pipe joints of various diameters are shown in Figure 1. These quantity estimates are based on actual field experience but may vary slightly in the smaller diameter pipe and substantially in the larger diameter pipe.

Some factors which may affect the quantity of AV-202 required are:
1. Original gasketing materials remaining in the joint.
2. Open or off-set condition of the joint.
3. Severity of infiltration or exfiltration at the joint.
4. Type and condition of grouting equipment to be used.
5. Application method used.

Estimating AV-202 Application Req. continued.

Other factors may affect quantities required. These figures are intended only as a guide.

In joints, the primary factor influencing the quantity of AV-202 Multigrout required to seal a given joint is the size of the joint gap. The amount of AV-202 required will be less if old joint compounds still partially fill the joint. As a rough rule of thumb, one fluid ounce of AV-202 will be required per lineal inch of joint having a gap of one inch between the bell and spigot.

Actual examination of joint conditions, coupled with considerable experience, is necessary to accurately estimate grout quantities. This is particularly true for sealing large diameter pipe joints as shown in Figure 1. In some instances, special equipment and techniques can be employed to reduce material quantities required without affecting the quality of the seal. Project planners are strongly encouraged to consult with an approved applicator of Avanti products or an experienced grouting contractor when preparing material cost estimates.

Application of AV-202 Multigrout

The EGP Technique

The Expanded Gasket Placement Technique (EGP) is the process whereby jute strips, soaked in AV-202, are then packed around various types of pipe to achieve a very effective seal. For further information concerning EGP, consult the Avanti EGP brochure, which can be downloaded from the Avanti website at www.avantigrout.com.

The V-PAT Technique for Sealing Joints and Cracks

The Variable Pressure Application Technique (V-PAT) can be used to apply pure AV-202 Multigrout resin in both cracks and expansion joints. The methods used for these two water control problems are somewhat different, but the basic steps are the same. The procedures for sealing cracks and joints by the V-PAT method may be found on the Avanti website at www.avantigrout.com.

Cleanup Procedures

Cleaning

Most day-to-day cleanup and purging of nonhydrated grout (liquid AV-202 that has not been exposed to water or moisture) from pumps, fittings, and hoses can be accomplished with AV-208 (Technical Grade Acetone). Although acetone is preferred, MEK or other solvents are sometimes used. When using solvents for cleanup, extinguish all sources of ignition in the area and observe proper precautionary measures for handling such materials. If small component parts must be cleaned of cured grout, it is best to disassemble and soak them in a 100% solution of AV-222 Grout Cleaner. (Always use polyethylene plastic or steel containers for soaking).

Cleanup Procedures continued.

Normally an overnight soak will dissolve most deposits and sufficiently soften them for easy removal.

To clean the entire grouting system, flush grout from system with up to 5 gallons of AV-208 (Technical Grade Acetone). Pump until acetone runs clean. **DO NOT REUSE.**

Safety During Cleanup

Acetone is flammable and the precautions necessary for any flammable material should be followed. Since grout compound which comes into contact with clothing cannot be removed, rain gear or disposable coveralls are highly recommended. Hats or hoods help keep the material from dripping into the hair during overhead application.

Handling and Storage of AV-202 Multigrout

Care must be taken in handling and storage of AV-202 Multigrout. The material is sensitive to moisture and moderately sensitive to high storage temperatures. Optimum storage is 40-60°F under fairly dry conditions. Storage temperature should not exceed 80°F. Properly stored, the material should have a useful shelf life of two years. Once a container has been opened, the useful life of the material is reduced.

Safety Procedures

Please refer to the Avanti AV-202 Multigrout MSDS available online at www.avantigrout.com.

Exposure

AV-202 Multigrout in nonhydrated or liquid form may cause skin and eye irritation following direct contact. If AV-202 comes in contact with skin, it should be washed off with soap and water. Material getting into the eyes must be flushed out immediately with water and a physician should be consulted. AV-202 Multigrout should not be ingested.

Before eating, smoking, or drinking liquids, remove protective clothing such as gloves and coveralls, wash hands with soap and water and stand away from the immediate work site. **DO NOT SMOKE** while working with AV-202 Multigrout. If respiratory difficulties are encountered when working with AV-202 Multigrout, obtain medical attention.

Users should avoid excessive exposure to vapors and keep the work area sufficiently ventilated to avoid exceeding the toluene diisocyanate Threshold Limit Value (TLV). Gloves, goggles, respirator, and protective clothing are recommended when working with this product.

Ventilation

Ventilation is an important aspect of project planning. Small amounts of toluene diisocyanate (TDI) may be present. A small segment of the population may be more sensitive to TDI than the norm. A respirator equipped with an organic vapor cartridge should always be available and ventilation augmented by blowers or fans when appropriate.

Safety Procedures continued.

Summary of Handling Precautions

1. Wear goggles and rubber gloves in handling and application operations.
2. Keep away from heat and open flame during storage and use.
3. Ventilate sufficiently and use respirator, especially for operations in a confined space.
4. If skin or mucous membrane is contaminated with Multigrout or its solutions, wash thoroughly with plenty of water. In case of eye contact, wash immediately with plenty of water and boric acid solution, and seek medical attention.

AV-202 Multigrout

UL Water Product Certification

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ANSI/NSF Standard 61 encompasses products that come in contact with drinking water and/or drinking water treatment chemicals. Products covered by this standard include:

1. Pipes and related products
2. Barrier materials, i.e., coatings, linings
3. Joining and sealing materials, i.e., adhesives, gaskets

Warranty Statement

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