VINILMUD P 30

VINILMUD P30 is a vinilic polymer characterised by a low anionic behaviour and quite low molecular weight. It is mainly used for the preparation of stabilizing and lubricating muds in drilling, civil engineering, pipe jacking and microtunnelling application. The VINILMUD P30 drilling fluid is easy to prepare and easy to dispose after usage, in fact VINILMUD P30 is a fully biodegradable polymer, non-toxic and safe for environment and users.

Its main characteristics are its stabilizing and lubricating properties and the possibility to be recycled many times also with the presence into the soil and into the water of bivalent ions and/or salts.

POLYMER MIX DESIGN

General

When the soil contain sand or gravel layers, it is proposed to use a **nominal** amount of bentonite in the slurry. This is recommended by most polymer manufacturers as an adjunct for the initial "sealing" of the borehole wall in the permeable layer.

It is important to note that the function of the bentonite is to act as a "filler" only and that the mix quantity is so small that the final drilling fluid mixture cannot and should not be considered as a bentonite slurry and subjected to the procedures and tests normally required or specified for bentonite fluids, unless described herein.

Mix Design

The initial mix design has been formulated for use in fine sand to yield the following properties:

Marsh Viscosity	> 50 sec
pH	9-10
Density	1.00-1.01

To achieve this, the drilling fluid mix design shall initially be as follows:

0,75 – 1 kg	Vinilmud P30 (powder)
8 – 10 kg	Bentosund 120 E
~ 0,5 kg	NaOH (varies to suit pH)
1 m^3	Water

After commencement of drilling, the marsh viscosity may be increased above 50 sec to control or reduce the fluid loss and to maintain borehole stability.

POLYMER MIXING PROCEDURE

General

Polymer mixing can be carried out without special mixing equipment by dispersing the polymer powder directly into moving water and moderately agitating the mixture. In emergency situations the polymer can be mixed in the borehole by sprinkling the powder into the recharge outlet of the fluid (or water) into the borehole.
However, in order to achieve optimum yield from the polymer fluid, and due to the intended use of bentonite in the mix, conventional slurry mixing equipment will be used. This is also ensures that the mix is immediately usable (i.e. is fully hydrated).

Mix Station Preparation

Prior to mixing, equipment and materials shall be properly prepared at a mixing station.

A water tank of minimum 20 m^3 capacity shall be kept at the mixing station for the purpose of having adequate quantities of mixing water.

A high speed recirculation mixer shall be used for both the bentonite premix and the polymer mixing.

A storage tank for the bentonite premix shall also be kept at the mixing station.

Storage tanks with a combined capacity equal to the pile volume shall complete the layout of the mixing station.

All slurry storage tanks shall be interconnected by a manifold system to enable the combined storage facility to be activated at any time. Each storage tank shall also be fitted with a 100 mm. submersible pump to enable mix circulation within and between the tanks.

Mixing

Mixing of the drilling shall be carried out in steps as follows:

Step 1 Adjust the pH of the mixing water in the water tank by the addition of NaOH (~ 0,5 kg/m^3 until pH 9-10 is achieved).

Step 2 Premix the bentonite with the mixing water (pH adjusted) at the required dosage. To minimize storage requirements, the premix can be mixed at a higher concentration and diluted to the required concentration during step 4 mixing. The bentonite solution shall be discharged to the bentonite premix tank.

Step 3 Allow the bentonite premix to hydrate (approximately 24 hours).

Step 4 Using the recirculation mixer, mix the polymer powder into the hydrated bentonite premix at the required rate (ie 1 kg/m^3). Increase the quantity of polymer powder as necessary to achieve the required viscosity.

Step 5 Discharge to the storage tanks.

The sequence of bored pile construction will enable alternation between mixing of bentonite premix and polymer drilling fluid. In the event that demand exceeds supply a second recirculation mixer shall be mobilized to facilitate mixing.

APPLICATION

General

Polymer drilling fluids are delivered to the borehole via pumps and pipelines in the same manner as conventional slurries.

Drilling fluid is added to the borehole before the excavation proceeds past the toe of the temporary or permanent casing.

The level of the drilling fluid is then maintained at about ground level at all times except as follows:

a) During drilling the fluid level will be allowed to fluctuate by 2 metres to the extent that when the drilling tool is in the borehole the fluid level is at or above ground level and when the drilling tool is out of the borehole (to discharge soil) the drilling fluid shall be more than 2 metres below ground level.

b) When the drilling tool is out of the borehole for protracted periods the fluid level shall be regularly “topped up” to be maintained at ground level but at no time shall it be allowed to drop lower than 2 metres.

c) For piles constructed in the river the drilling fluid level shall be kept at or above water level at all times.

Base Cleaning

Unlike other drilling fluids, polymer drilling fluids do not hold detritus or soil in suspension and therefore do not require recycling.

After drilling has reached the final level, the “cleaning bucket” is used to clean any loose or remoulded material from the base.

The borehole is then left standing for approximately 20 minutes to allow detritus and soil particles to settle to the bottom of the borehole. After 20 minutes the borehole depth is remeasured to determine the depth of sediment. The borehole is then remeasured at 10 minute intervals until the sedimentation level has finally settled. Final settlement can be demonstrated by plotting a graph of depth versus time. Full settlement is normally achieved at about 30 minutes but can vary based on pile diameter and soil condition.
It should be noted that one of the features of polymer drilling fluids is that the polymer causes the soil particles and detritus to flocculate and settle quickly.

After achieving final settlement, the base of the borehole is recleaned using the “cleaning bucket” to remove the sediment. When recleaning is completed, the depth of the borehole is remeasured.

After installation of the reinforcement cage, the depth of the borehole will be rechecked and the base may require recleaning to remove any soil deposit or sedimentation caused during cage installation. Should recleaning be required this will be done using the “air lift” method.

Recycling

During concreting, the slurry is pumped back to the storage tanks for regeneration and reuse. The rate of pumping is controlled to coincide with the rate of flow of the concrete such that the fluid is maintained at about ground level to maintain borehole stability.

In the recycling process, slurry with a density greater than 1.05 g/ml will normally be routed to the storage tanks via a "settling tank" where any silts or very fine particulate matter are able to settle out of the slurry before going back into circulation.

In the final stages of concreting, the pH of the slurry is checked to determine the point at which to discontinue return of the slurry to the storage tanks. Free calcium in the concrete neutralized the polymer in the contact zone and raises the pH. In this case, when the pH of the polymer reaches 12 it is not practical to regenerate or recycle it and this material should be discarded. As for most drilling fluids, as a general rule, at least the top two metres of slurry (above the concrete surface) is discarded.

The regeneration of recycled slurry for reuse involves two steps, adjust the pH and adjust the viscosity:

- pH will normally be high and should be adjusted by the addition of NaOH.

- Viscosity will either be higher or lower then the original mix viscosity. If the viscosity is higher, the density should be checked to determine whether or not the slurry requires "resting" in the settling tanks. If the density is lower than 1.05 but the viscosity is high, the slurry can be diluted to the required viscosity. If the viscosity is low, the slurry is reconstituted by the addition of polymer powder to achieve the required viscosity.

Disposal and Cleanup

Short term disposal of unwanted polymer is carried out by mixing hydrogen peroxide (3% concentration) or sodium hypochlorite in the ratio 1:100 with the polymer slurry to be discarded. This will breakdown the molecular structure of the polymer chain to leave no trace of the original product. The resultant fluid has the viscosity of water, is inert and is harmless and can be disposed of by discharging into drains or discharging onto the site.

In the long term the polymer is degraded by microorganisms and is also sensitive to ultraviolet light resulting in degradation on exposure to sunlight.

In the event of accidental spillage into waterways, the polymer is naturally diluted and is non toxic and harmless to the environment.

Storage

It is not necessary to maintain large volumes of polymer drilling slurry on site.

Normally storage is only required for the bentonite premix and for sufficient volume for the recycled slurry for regeneration, however, it is proposed to have at least the volume of one borehole in store.

The speed of mixing the slurry and the use of a high speed recirculation mixer (providing immediate hydration) means that the polymer can be mixed faster than the rate of drilling and that the polymer can also be mixed on demand.

TESTING

General

All testing will be in accordance with the standard procedures laid down in API RP 13B-1 or ASTM D 4381 as later described. The test for viscosity is a modified version of API RP 13B-1 due to the nature of the polymer.

Test Procedure

The testing procedures for polymer drilling fluid will be as follows:

a) Fluid Viscosity – tested using the Marsh Funnel test (API RP 13B-1) but modified in that the slurry is not poured through the screen of the funnel. This modification is required because the polymer slurry may not pass through the #12 mesh screen on the top of the funnel. The slurry is therefore poured directly into the open side of the marsh funnel. The viscosity (measured in seconds) is based on a measured quart (946 ml).

b) Density – the density of the slurry is measured using a mud balance in accordance with API standards (API RP 13B-1).

c) pH – measured using pH indicator paper or an electric pH meter (API RP 13B-1).

d) Sand content – determined in accordance with API standard (API RP 13B-1 or ASTM D 4381).

Testing Frequency

Testing frequency will be as follows:

No.	Test	Frequency		Requirement
1.	Viscosity	1.1	After mixing	> 50 sec *
		1.2	Before discharging to borehole	> 50 sec *
		1.3	During drilling	> 50 sec *
		1.4	Before concreteing	> 45 sec *
2.	Density	2.1	During drilling	< 1.10 g/ml
		2.2	Prior to concreting	< 1.05 g/ml
3.	PH	3.1	After mixing	9-10
		3.2	During drilling	9-10
		3.3	Before concreting	9-10
4.	Sand Content	3.1	Prior to concreting	< 5%

* or such higher value as determined at site

MATERIALS

Water

Water shall be potable water taken from the municipal supply either at the site or delivered to site in water tankers.

Bentonite

Bentotnite shall be Civil Engineering grade bentonite type BENTOSUND 120 E.

Polymer

Polymer shall be an anionic water soluble synthetic polymer type VINILMUD P30, supplied in powder form. Material shall be supplied to site in polythene lined bags.