FILTRATION AND DRAINAGE

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Revised: May 18, 2010

This technical note focuses on the use of geotextiles in filtration and drainage applications. TenCate manufactures and markets both woven monofilament and nonwoven needle punched polypropylene geotextiles, the products of choice for filtration and drainage applications.

Woven monofilament geotextiles are 2-dimensional products with a distinct orientation of fibers, uniform opening size and a high percent open area. These products typically have an apparent opening size (AOS) larger than or equal to 0.21 mm (#70 sieve) and a percent open area (POA) of at least 4%. In any application, a geotextile with a higher POA will be less susceptible to long-term clogging or blinding.

Nonwoven needle punched geotextiles are 3-dimensional products with a random orientation of fibers and random opening size. These products typically have an AOS less than or equal to 0.21 mm (#70 sieve).

Not all soils are created equal, and not all applications are the same in terms of boundary conditions (i.e. confining stress and flow conditions) and hydraulic gradients present at the geotextile interface. In some circumstances a woven monofilament would be better suited for the application; while in other cases a nonwoven geotextile would be better suited. Further, many times either type of geotextile will perform equally as well, and there are times when neither type of geotextile will perform very well. TenCate promotes the proper design of the geotextile filter based on the application and boundary conditions, including both soil and hydraulic conditions. Some “Helpful Hints” with respect to filtration and drainage are as follows:

- In high gradient coastal shoreline applications, a woven monofilament geotextile having a high POA should be favored because of its ability to release hydrostatic pressure quickly through its 2-dimensional open structure. However, be careful to properly consider the soil retention criterion based on the soil and hydraulic conditions.

- In the leachate collection system of a landfill, research has shown that a woven monofilament with an AOS of 0.42 mm and at least 10% open area provides the best resistance to microbiological clogging. Choose FW300, FW402, FW403 or FW500 for this application.

- Stay away from slit film (slit tape) geotextiles such as Mirafi 500X and 600X for any filtration and drainage application. Although these products have a large AOS, don’t be fooled. These products have only 1% to 2% open area and are considered a clogged filter before even entering a soil environment. Percent open area does matter!

- For gap-graded cohesionless soils, research has shown that a woven monofilament with a percent open area of at least 10% should be favored. Check the retention criteria to determine AOS requirements.

- For soils with a high silt content (>20%) and a low plasticity index (PI < 5), research has

shown that nonwoven geotextiles may experience clogging or blinding. Consider using a woven monofilament geotextile and increase the size of the downstream drainage area.

- When filtering non-dispersive clay soils (PI > 5), use a heavy weight nonwoven. Choose Mirafi 180N or heavier geotextile.

- Under high overburden pressures and where the downstream drainage area is small, low modulus nonwoven geotextiles may intrude into the drainage area causing a restricted flow path. As long as the retention criterion is satisfied, favor a higher modulus woven monofilament geotextile or be sure to increase the size of the downstream drain to account for geotextile intrusion.

- Silts are troublesome. Nonwoven geotextiles often clog or blind, and woven geotextiles may allow piping. Consider increasing the size of the downstream drain and wrapping it with a woven monofilament geotextile. For critical applications, place six (6) inches of fine sand between the silt soils and the geotextile, and design the geotextile filter based on the gradation of the adjacent fine sand.

- Wrapping a pipe with a geotextile, in general, is poor practice and should not be done unless the soil adjacent to the geotextile is a clean sand or stone. The best design is to place the geotextile filter around the perimeter of a drainage trench, with the pipe encapsulated in stone.

- For critical applications, consider conducting a laboratory test to assess the performance of the geotextile filter subjected to the actual soil and hydraulic conditions. There are two tests available: the Gradient Ratio test (ASTM D5101) and the Hydraulic Conductivity Ratio (HCR) test (ASTM D5567). Use the Gradient Ratio test for coarse-grained soils and the HCR test for fine-grained soils. Note that neither test can assess the performance of the geotextile in dynamic, reverse directional, or turbid flow conditions. For concerns relating to microbiological clogging of the geotextile for leachate collection systems, perform ASTM D1987: Biological Clogging of Geotextile or Soil/Geotextile Filters.

It should be noted that the recommendations provided above are based on generally excepted filtration design procedures such as those presented in TenCate's Geotextile Filter Design Manuel, developed by Geosyntec Consultants, Inc.