FLUET, J. E., Jr.
J.E.F. Associates Inc., Boca Raton, Florida, USA

Full Scale Railroad Geotextile Testing Procedures

Examens completes de géotextiles-chemin de fer

During the past several years, many railroad lines have conducted full scale in-service tests of various geotextiles. Unfortunately, some of the results of these tests are difficult to correlate, and are often fragmented, invalid, or even unrecorded. This paper describes testing procedures and methods which have been shown to provide clear, useful, analytical results. Accordingly, the paper should provide railroads with a checklist, if not a guideline, for conducting future geotextile tests.

Pendant plusieurs annees passees, beaucoup de lignes de chemin de fer ont donne les examens completes de geotextiles. Malheureusement, beaucoup de resultats de ces examens sont difficiles de mettre en correlation et sont souvent fragmentes, invalides, ou meme pas enregistres. Ce papier decrit les procedes des examens et les methodes qu'on montre pour donner les resultats clairs, utiles et analytiques. En consequence, le papier doit donner aux chemins de fer une liste de controle si non la norme pour conduire les examens geotextiles.

INTRODUCTION

Throughout this paper, the assumption has been made that geotextile test sites shall involve existing track as opposed to new construction, simply because existing sites typically are exposed to much more severe conditions. Specifically, an existing site is likely to have been chosen because it already is troublesome. Additionally, the geotextile is abraded much more severely when installed following an undercutting operation.

Types of Geotextiles Available

References 1 and 2 will provide the reader with a detailed description of the various types of geotextiles as well as their manufacturers and distributors.

It should be noted, however, that railroad tracks are usually considered the most severe application for geotextiles. Notably, the abrasion resistance required is particularly critical (elsewhere in these proceedings, Dr. G. Raymond discusses the value of resin bonding in abrasion resistance); lateral drainage may be required in which case a thick, needlepunched nonwoven or composite fabric will work best; and tensile strength is more critical in the cross-track or transverse direction of the fabric, than in the trackwise, machine direction of the fabric (see reference 3). Other considerations such as burst strength and puncture resistance may also be critical.

In any case, it is to the best interest of all concerned to test as many products as practical. Accordingly, at least one manufacturer of each of the following types of geotextiles should participate:

- Wovens
- Heat-bonded nonwovens
- Needle-punched nonwovens
- Composites

These manufacturers should be especially encouraged to donate new or improved products for testing and evaluation.

Test Site Selection

If at all possible, the test site should be a straight section of normally high speed, high volume, high tonnage double track. Both tracks should be undercut and rehabilitated. The geotextiles should be installed on one side, with the other side serving as a "control" section. The section of track should be troublesome, i.e. one which has required frequent re-surfacing or undercutting.

The test section should be sufficiently long to allow the installation of at least one hundred feet of each fabric to be tested; and the adjacent terrain and subgrade conditions should be consistent in order not to prejudice any fabric results. Finally, shoulder drainage should be provided (clean swales will suffice) in order to check the lateral drainage capabilities of the geotextiles.

Geotextile Installation Techniques

The two normal methods are:

(a) Lay the fabric out alongside the track, then manually pull it under the track, or
(b) attach the fabric to a roller on the side or beneath the undercutter.

Both methods should be tried and evaluated.

Installation Records

The following data should be collected at the time of installation:

(1) Precise stations which locate the beginning and end of each type of fabric.
(2) The width of each type of fabric.
(3) The planned depth of each fabric below the rail - record data beneath each rail and at centerline.
(4) Type of ballast, i.e., granite, limestone, Open hearth slag, etc.
(5) Condition of ballast, i.e., new, cleaned, partially cleaned, etc.
(6) Take soil sample of fines in ballast if it is not clean. (Use airtight bag.)
(7) Take soil sample beneath the fabric. (Use airtight bag.)
(8) Analyze moisture content and grain size distribution for (6) and (7) above.

Photographic Documentation

Because of the large number of photographs likely to be taken at each site "opening", it is critical that the photographs be adequately documented. To do otherwise is to invite mass confusion because the photographs will be impossible to identify.

Accordingly, the following information should be clearly printed on a slate board:

Fabric Type
Date
Station

The slate board should then be placed such that its information will be seen in each photo. Note that because there may be a large number of manufacturer's representatives wishing to take their own photos, the slate must be carefully placed, all the photos taken for that particular situation, then the slate must be moved for the next shot, etc. However tedious, this procedure should be considered imperative.

Frequency of Inspection

The actual frequency of inspections may vary from test site to test site, depending on the severity of the problems and the effectiveness of the geotextiles. Nonetheless, the minimum recommended frequency is semi-annually for the first two years, annually for the next three years, and bi-annually thereafter.

Site Inspections - "Openings"

The first item to note prior to opening the track to expose the fabric, is whether there has been any track mis-alignment or deformation - if so, these should be carefully documented.

Each type of fabric should then be exposed, at the same relative location (e.g., 20 feet from the leading edge). Each of the following procedures should be photographed, being careful to document as described above. Additionally, each of the airtight bags referred to below should be similarly documented, i.e., fabric type, date, and station.

(1) Remove one tie.
(2) Remove the ballast above the fabric. Within four inches of the fabric, this procedure must be done manually, with great care, in order to preclude damage to the fabric.
(3) Obtain a sample of the "fines" above the fabric, and place in an airtight bag. Then remove all of the ballast above the fabric.
(4) Clearly mark the fabric such that the region one foot each side of each rail can be identified, then cut out a piece of fabric 18 inches wide across the width of the track. Place the fabric in an airtight bag.
(5) Obtain a soil sample from beneath the fabric and place in an airtight bag.
(6) Measure the distance beneath each rail to the fabric, as well as the centerline distance to the fabric.
(7) Replace the removed section of fabric with new fabric, being careful to overlap at least 12 inches.
(8) Replace the ballast and tie.
(9) If the site is a double track, take the appropriate samples from the "control" track.

Laboratory Testing

The following laboratory tests should be performed on the fabric and soil samples:

(1) Geotextile Tests
  (a) White light penetration test for punctures (sample under rail)
  (b) Observation for "accomodation",i.e., "bumps" but no punctures (see reference 3) (Sample under rail)
  (c) Tensile tests in both cross-track and track-wise directions (Sample under rail)
  (d) Permeability
  (e) Mullen Burst
  (f) Other possible tests are
    - dry weight change after washing
    - moisture content
    - puncture resistance
    - lateral permeability
    - trapezoidal tear
    - etc.
(2) Soils - Ballast
  - moisture content
  - grain size distribution
  - soils analysis

Laboratory Selection

Several manufacturers have excellent laboratory facilities which can be used, provided other manufacturers do not object. In any case, a number of independent soils testing laboratories now have geotextile testing facilities.

Presentation of Results

Particularly if the tests were conducted by a manufacturer's laboratory, results should be presented as determined, with no editing or comment. For example, as the soils are analyzed, no comment should be made regarding the geotextile propensity for trapping or draining moisture. Such interpretation should be reserved for those whose task it is to interpret, as discussed in the nest section.

Interpretation of Results

As soon as the testing results are completed, copies should be sent to each manufacturer as well as a minimum of two independent geotextile consulting engineers for comment and interpretation. All of these comments may then be compiled, either by another geotextile consultant or by railroad personnel, into a final report.

SUMMARY

Perhaps the most critical step of all in such full scale railroad testing is the publication of the results as soon as possible, in order that the level of knowledge may be improved for the industry at large. There may be objections by some manufacturers to such publication due to the relatively poor performance of their products. The obvious response to such objections is that manufacturers must be willing to take the risk of failure in such testing in order to properly evaluate and improve their own products. Indeed, both the railroads and the geotextile industry can only benefit through the publication of such results.

Acknowledgements

The author wished to thank Mr. Walter L. Heide and Mr. A. H. Bair of the Consolidated Rail Corporation. Their careful and professional conduct of the Conrail "Loudenville" tests contributed much invaluable experience to all concerned: railroads, consultants, academicians, and manufacturers.

References

(1) Bell, J.R. and Hicks, R.G., et. al., "Evaluation of Test Methods and Use Criteria for Geotechnical Fabrics in Highway Applications". Interim Report, June 1980, Federal Highway Administration Office of Research and Development.

(2) Koerner, R.M. and Welsh, J.P., Construction and Geotechnical Engineering Using Synthetic Fabrics, John Wiley and Sons (New York, 1980).

(3) Fluet, J.E.,Jr., "Geotextiles for Railroads - A Short Course", Industrial Fabric Products Review, Vol.58, No. 2, July 1981, I.F.A.I.,Minneapolis,Minn.