



বাংলাদেশ পানি উন্নয়ন বোর্ড
সচিবালয়
ওয়াপাদা ভবন, মতিঝিল বা/এ, ঢাকা।

স্মারক নং-বাপাউবো(সচি)/পরিকল্পনা/কা-প্র-২০২০/০৫

তারিখঃ ২৩-০১-২০২০ খ্রি

বরাবর,
প্রধান প্রকৌশলী,
ডিজাইন,
বাপাউবো, ঢাকা।

বিষয় : নদী তীর সংরক্ষণ কাজে ব্যবহৃত জিওব্যাগ/জিওটেক্স্টাইলের উপর দাখিলকৃত কারিগরি কমিটির প্রতিবেদন অনুমোদন প্রসংগে।

- সূত্রঃ ১। স্মারক নং-৪০-প্র.প্র.ডি/সা, তারিখঃ ১২.০১.২০২০ খ্রি
২। স্মারক নং-বাপাউবো(সচি)/পরি-১/বিবিধ-৩/২০১৯(১ম খণ্ড)/১৪৫, তারিখঃ ০৩/০১/২০২০ খ্রি

মহোদয়,
যথাযথ সম্মান পূর্বক উপর্যুক্ত বিষয় ও সূত্রান্তরিত স্মারকসময়ের বরাতে জানাচ্ছি যে, নিম্নবর্ণিত কারিগরি প্রতিবেদনটি বোর্ড কর্তৃক অনুমোদিত হয়েছে (মহাপরিচালক মহোদয়ের ডায়েরি নং-৫৮০৩, তারিখঃ ২০/০১/২০২০ খ্রি)।

নদী তীর সংরক্ষণ কাজে ব্যবহৃত জিওব্যাগ/জিওটেক্স্টাইলের উপর গঠিত কারিগরি কমিটির প্রতিবেদন।

এমতাবস্থায় অনুমোদিত কারিগরি কমিটির দাখিলকৃত প্রতিবেদনটিতে উল্লিখিত মতামত ও সুপারিশের আলোকে সদয় পরবর্তী প্রয়োজনীয় ব্যবস্থা গ্রহণের নিমিত্ত কারিগরি প্রতিবেদনটি এতদসঙ্গে আদিষ্টমতে প্রেরণ করা হলো।

সংযুক্তি : কারিগরি কমিটির প্রতিবেদন-১ প্রস্তুত।

২৩/০১/২০২০
(মোঃ সামিউল ইসলাম খান)
উপ-সচিব (পরিকল্পনা)
বাংলাদেশ পানি উন্নয়ন বোর্ড
ঢাকা।

বিতরণ (জ্ঞাতার্থে/কার্যার্থে):

- ১-২। প্রধান পরিকল্পনা/মনিটরিং, বাপাউবো, ঢাকা।
৩-১৩। প্রধান প্রকৌশলী/অতিরিক্ত প্রধান প্রকৌশলী, পানি বিজ্ঞান/পওর পরিদণ্ডন/যান্ত্রিক সরঞ্জাম পরিদণ্ডন/দ্রেজার পরিদণ্ডন/কেন্দ্রীয় অধ্যুল/দক্ষিণ-পূর্বাধ্যুল/পূর্বাধ্যুল/উত্তর-পূর্বাধ্যুল/ উত্তর-পশ্চিমাধ্যুল/ পশ্চিমাধ্যুল//দক্ষিণ-পশ্চিমাধ্যুল/দক্ষিণাধ্যুল/উত্তরাধ্যুল, বাপাউবো, ঢাকা/ নারায়ণগঞ্জ/চট্টগ্রাম/কুমিল্লা/সিলেট/রাজশাহী/ফরিদপুর/খুলনা/বরিশাল/রংপুর।
১৪। সিস্টেম এনালিস্ট, আইসিটি সেল, বাপাউবো, ঢাকা। বাপাউবো'র ওয়েবসাইটে প্রকাশের অনুরোধসহ।
১৫। সি এস ও টু মহাপরিচালক, বাপাউবো, ঢাকা।
১৬-১৮। পিএ টু অতিরিক্ত মহাপরিচালক (পরিকল্পনা/পশ্চিম রিজিয়ন/পূর্ব রিজিয়ন), বাপাউবো, ঢাকা।

জ্ঞানকী নং ৭৮	তারিখঃ ২৪/০১/২০২০
* কৃতিবৃক্ষ অনুমতি / নিম্নলিখিত * কৃতিবৃক্ষ অনুমতি তিনি: ২৪/০১/২০২০/ * অনুমতি করেন কর্তৃপক্ষ * অনুমতি করেন / অনুমতি কর্তৃপক্ষ * অনুমতি করেন / অনুমতি কর্তৃপক্ষ * অনুমতি করেন / অনুমতি কর্তৃপক্ষ	

BANGLADESH WATER DEVELOPMENT BOARD



**Technical Report
on
Durability of Geotextile**

January 2020

12 Recommendations

1. Polypropylene and polyester shall not be mixed in the same Geotextile fabric because
 - i. The chemical composition, mechanism of degradation, Resistance to weathering, creep resistance etc. of polypropylene and polyester are not similar.
 - ii. In our working environment or in normal operating temperature, Polypropylene remains in a plastic state, whereas Polyester remains in a hard, brittle state.
 - iii. Sunlight is critical for polypropylene, whereas Relative Humidity (i.e water) is critical for polyester.
 - iv. Durability test procedure, Weathering test procedure etc. are different.
 - v. For polypropylene, for Durability test, oxidative degradation process is accelerated either by raising the temperature or by increasing the concentration of oxygen.
For polyester, accelerated tests are performed by immersing the PET products in hot water.
 - vi. For polypropylene, result is obtained on the basis of 50% reduction 'on strength.'
 - vii. For polyester, result obtained on the basis of Molecular weight (Mn) and count of carboxyl end group (CEG) in addition to 50% reduction on strength.
 - viii. In civil engineering applications polyesters are used below their glass-transition temperature, Tg while polypropylene and polyethylene are used above Tg.
 - ix. Polyester mainly used as a reinforcing material. Polypropylene used as a non-reinforcing material. Geotextile fabric are used as a non-reinforcing material, in case of filter and Geobag.
 - x. In BWDB, Geotextile fabrics are used for filter and Geobag, which is always in contact with or submerged in water. As Relative Humidity (i.e water) is critical for polyester, so, polyester shall not be used in Geotextile fabrics in case of filter and Geobag.
 - xi. Polyester can also be susceptible to heightened degradation where there is lime treated soil, concrete or cement present. In River Bank protection work, as Geotextile or Geobag always are in close contact with CC Block, so, polyester material shall not be used here.
 - xii. EN ISO 13438 & EN 14575 are used for "Durability test" of polypropylene. Whereas EN 12447 are used for "Durability test" of polyester. There is no test for Durability, when polypropylene and polyester are mixed.
2. Durability test for polypropylene or polyester and it's Uncertainties
 - i. EN ISO 13438 & EN 14575 are used worldwide for "Durability test" of polypropylene.
 - ii. EN 12447 are used worldwide for "Durability test" of polyester.

- iii. Durability is determined on the basis of degradation of polypropylene or polyester. There is generally no fundamental law covering degradation and most curves are empirical.
- iv. EN ISO 13438 & EN 14575 are termed as screening test with the purpose of eliminating poor quality material.
- v. EN ISO 13438, EN 14575 & EN 12447 can ensure a lifetime of 25 years under set of environmental conditions.
- vi. Equivalent tests are not yet available for durations of lifetime more than 25 years. Still there are lot of controversy, debate and question regarding the test available worldwide for to determine the "Durability" of polypropylene or polyester. Recently EN ISO 13438:2018 provides a method for Screening the resistance to oxidation for Geotextiles and geotextile-related products in service for 25 years and more.
- vii. It is to be mentioned here that Index tests is only valid where the rate of degradation is uniform (as in case of Mode 2) i.e for polyester.
- viii. Since the first geotextile installation occurred in North America in 1958, it is not possible to demonstrate 100-year durability with 'real-time' success stories.
- ix. Still there are lot of controversy & debate regarding to perform the oxidation test by Oven or Autoclave.
- x. Durability test is very time consuming. Some time it takes several months to year.
- xi. Moreover, these tests are very costly and not available in Bangladesh. These tests are also not widely available through the world.

3. Revised Code for Durability test

- i. The international standard EN ISO 13438:2004 provides a method for Screening the resistance to oxidation for Geotextiles and geotextile-related products in service for 25 years.
- ii. Recently, ISO 13438:2004 was revised by ISO 13438:2018. This standard provides method for screening the resistance to oxidation for Geotextiles and geotextile-related products in service for 25, 50 and 100 years. Testing facilities for ISO 13438:2018 are very costly and not available in Bangladesh. Geotextile produces in Bangladesh, are not yet tested for ISO 13438 test.

4. Allowable maximum exposure time during installation

Geosynthetics for all applications have to be tested (Index Test EN 12224 :2000) for resistance to weathering. Ultraviolet Resistance shall be tested to determine allowable maximum exposure time before covering during installation. It was found that the most common causes of degradation were from incorrect materials selection or structural design, followed by installation damage and weathering.

The maximum exposure times are set out as below:

Retained strength after testing <u>according to EN 12224</u>	Allowed maximum exposure time (uncovered) during installation
>80 %	1 month
60 %-80 %	2 weeks
<60 %	1 day
Untested material	1 day

5. Additives in polypropylene

100 % polypropylene shall not be used. Under normal conditions pure unstabilized PP can degrade within a year, even in the dark. An additive is a substance which is added in a small quantity to a polymer to modify its properties for a particular purpose i.e. which arrest or retard degradation and extend polymer life. Principal additives are used in Polypropylene such as antioxidant stabilizers, UV-stabilizers, metal deactivators and acid scavengers. In polypropylene, 1 to 2 % additives shall be used.

Chimassorb 944—a UV stabilizer belonging to the HALS (hindered amine light stabilizers) family may be used as an additive.

2% carbon black and 1% antioxidants may be mixed in the PP base resin to produce the PP fibers.

6. Expert and Expert Institutions are needed for Durability test:

Due to complexity and serious uncertainty, Lifetime assessment of Geotextile is an assessment, made by experts on the projected service life of a geosynthetic. Any prediction is an estimate only. Durability assessment can only be done by experienced institutes or sworn experts. In Europe only a few institutes have experience to execute the tests and to do a proper assessment. The assessment of durability for more than 25 years in Europe only be executed by an institute certified under the CE mandate.

7. Recycled or Post-consumer polymers shall not be used

- i. There are two method of recycling i.e Mechanical recycling & Chemical Recycling.
- ii. Mechanical recycling is accomplished by melting. This thermal bonding process cannot bond the fibres as tightly and strongly together as virgin fibre. The end product of Mechanical recycling is a lower quality product. Moreover, consistency of quality cannot be maintained during Mechanical recycling. Most recycling is done mechanically as it is relatively cheap.
- iii. Chemical Recycling involves using chemicals to break down, or depolymerize, the polyester fiber back into its original monomers, which can then be polymerized back into new materials. Chemical recycling does create a new plastic which is of the same quality as the original, but the process is very expensive and is almost never done.

- iv. There is a trend to uses recycled polyester with polypropylene, to reduce cost. As Chemical Recycling is very expensive, polyester is recycled through Mechanical recycling. End product of Mechanical recycling is always a lower quality product than original one.
- v. From various experiment it was found that Strength of recycled polyester are very much low than that of virgin one. From experiment it was found that air permeability, tensile strength, tear strength decreases with the increase of recycled polyester.
- vi. In an experiment, it was found that, various properties of Geotextile (PP + recycled fibers) deteriorates with the decrease of percentage of polypropylene in Geotextile.
- vii. A hazardous chemical called antimony trioxide is used as a catalyst during the manufacture of PET resin. The PET resin is used to make both plastic bottles and virgin polyester. There have been many research studies that show that antimony trioxide has suspected carcinogenic potential for humans. As per USEPA, maximum contaminant level (MCL) of antimony concentrations in the water is 6 ppb. However, this threshold of 6ppb exceed at elevated temperatures of 60, 70 and 80°C, at the exposure durations of 176, 12 and 2.3 days respectively. These elevated temperatures are the most common routes for antimony to potentially leach out of polyester fiber into wastewater.
- viii. The polymers should not contain post-consumer recycled material. Re-worked polymer may be used under certain conditions. In the revised EN application standards, it is expected to be allowed to use Post-consumer Material and Post-Industrial Material for service lives up to 5 years and in non-reinforcing applications. Equivalent tests are not yet available, when recycled materials are used, provided that they are of a constant and controlled quality.
- ix. It is not sure, the Geotextile produced in Bangladesh, with virgin polypropylene, whether it will pass ISO 13438 test, a method for Screening the resistance to oxidation for Geotextiles and geotextile-related products in service for 25 years or more. Under this situation, if recycled polyester is mixed, then "Lift Time" of Geotextile will fall further. "Lift Time" of Geotextile with mixed of polypropylene and polyester (recycled) may be 5 to 10 years. So, mixing of polypropylene and polyester (recycled) shall not be done.

8. Align with Delta Plan 2100

- i. There is a Government directive to align all projects in the light of centenary Delta Plan 2100. So, the spirit of Delta Plan 2100, demands that, filter and sand filled Geobag shall sustain for 100 years. BWDB design River Training Work with 100-year frequency. So, Geotextile shall be tested according to ISO 13438:2018 for durability.
- ii. To align with the spirit of Delta Plan 2100, the use of "Durability Test" or Weathering Test" for Geo-textile material is an essential and immediate task. Geo-textile material for River Training Work shall not be used without "Durability Test" or Weathering Test".

- iii. The engineers of BWDB shall be trained to enhance their knowledge regarding theoretical & practical aspects of “Durability Test” or Weathering Test”; Better option is to do this, is in those laboratories as well as in those universities or institutions, where these tests are performed.
- iv. To facilitate and expedite river training work, one central and nine zonal laboratories may be established under BWDB. In this connection, to observe the testing facilities and procedure of testing foreign laboratory such as SKZ, KIWA, ITT, BAM, BTTG, BBA, INTRON etc. needs to visit urgently.
- v. “Durability Test” and Weathering Test” shall include in the BWDB’s Technical Specification.
- vi. Like European Standard, the Geo-textile Product manufacturer must certify the performance (value) of their product describing different properties such as Effective Opening Size O₉₀, mass, thickness, Strength, Elongation, Maximum Exposure Time, Durability (or Life time) etc.

Annex A : Accredited Institutes for testing of Geotextile Material

The tests for the assessment of life time for a period of more than 25 years may only be executed by laboratories and institutes that are especially accredited and certified for these tests and evaluations. The accrediting and certification must be made according to EN ISO 17025 by an institute that is especially notified for that. Some Institute are as below:

1. SKZ -TeConA GmbH
Friedrich-Bergius-Ring 22
97076 Würzburg
Germany
www.SKZ.de
2. KIWA- TBU- Institut für Textile Bau- und Umwelttechnik GmbH
Gutenbergstr. 29
48268 Greven
Germany
www.tbu-gmbh.de or www.kiwa.de
3. ITT - Institut für Technische Textilien GmbH
im Sächsischen Textilforschungsinstitut e. V.
Annaberger Straße 240
09125 Chemnitz
Germany
www.stfi.de
4. BAM Bundesanstalt für Materialforschung und –prüfung
Fachgruppe IV.3, Abfallbehandlung und Altlastensanierung
Dr. rer. nat. Werner Müller
Unter den Eichen 87
12205 Berlin
Germany
www.bam.de
5. TNO industrie en techniek
De Rondom 1
5612 AP Eindhoven
The Netherlands
www.tno.nl

The evaluation, control, auditing and certification for durability for a period more than 25 years may only be made by an, under the CE-Mandate certified, institute. This CE-Mandate is outlined in the Construction Products Directive CPD, 89/106/EEC, 1988, amended in 1993 door Directory 93/68/EEC.

These institutes, also called "notified bodies" are identified by a number of 4 digits before the letters CPD. This number must be indicated on all certificates issued by them. The list of notified bodies is published under nr 45 (2002), C282/01.

Notified bodies : A notified body is an organization designated by an EU country to assess the conformity of certain products before being placed on the market. These bodies carry out tasks related to conformity assessment procedures set out in the applicable legislation, when a third party is required.

The above 4 Institutes of Germany are also "notified body". Besides the above, list of some more "notified bodies" are given below :

6. BBA, British Board of Agreement
Bucknalls Lane,
Garston, Watford, Hertforshire,
United Kingdom, WD259BA
7. BTG, BTG Testing & Certification Ltd
Technology Services, Unit 4B, Stag Industrial Estate,
Atlantic Street,
Broadheath, Altringham, Cheshire, WA14 5DW
8. INTRON Certificatie BV
Venusstraat, 2 Inspectie-instantie
PO Box 267, 4105 JH
NL-4100 AG Culemborg
The Netherlands
9. KIWA NV, Certificatie en keuringen
Sir Winston Churchilllaan, 273
Postbus 70
NL-2280 Ab Rijswijk
The Netherlands

The last 2 institutes do not have experience with evaluation and certification of geosynthetics above 25 years.