How do certification schemes of geosynthetics make expected benefits of the use of geosynthetics more reliable

Pierre Lebon
ASQUAL, France

ABSTRACT – Many of the last studies about the use of geosynthetics impacts deal with the reduction of the negative impacts on the Environnement and the overall costs of the civil engineering works: reduction of the CO_2 emission, reduction of the cumulated energy demand, increase of the durability and reduction of the maintenance during the phase of use of the civil engineering works (1).
These benefits are related to the many factors as:

- the knowledges of the geosynthetics by the engineering and design offices in charge of draw up the technical contract conditions;
- the quality and consistency of the geosynthetics products characteristics;
- the installation of geosynthetics products;
- the durability of the geosynthetics products characteristics.

In a view to provide a clear and confident information on the geosynthetics products and products manufactured with high quality specifications for ensuring the repeatability of the products characteristics, a French non benefit organisation (ASQUAL) has developed several certification schemes on geotextiles and geomembranes, geomembranes application services (welding and construction site managing).
This article aims to provide information on the added value of the certification for all geosynthetics stakeholders, including both main contractors and prescribers in civil engineering than geosynthetics producers or products applicators.

Keywords: geosynthetics, certification of products, certification of services, ASQUAL scheme.

1 INTRODUCTION

As products are designed, produced, distributed, used and ultimately disposed of, they may give rise to concerns among purchasers, users and society in general.

A very frequent concern is simply whether a product or a service have the attributes claimed by its supplier. Such attributes could relate to safety, environmental impacts, durability, compatibility, suitability for intended purposes or for stated conditions, and similar considerations.

The term “product” in the rest of this article will apply both for tangible product and service.

Generally these concerns are addressed in the first place by specifying the required attributes in a normative document such as a standard. The supplier of the product then has the task of demonstrating that the product conforms to the requirements of the standard. It might be sufficient for the supplier to assess and declare conformity on his own responsibility but in some cases the product user or the regulatory authorities may require an independent and expert assessment in order to provide a sufficient level of confidence that the product possesses the required attributes. In other cases the supplier may choose to have conformity assessed by an independent body in order to more effectively achieve market acceptance.

The overall aim of certification is to give confidence to all interested parties that a product fulfils specified requirements. The value of certification is the degree of confidence and trust that is established by an impartial and competent demonstration of fulfilment of specified requirements by a third party.

2 DEFINITION OF A CERTIFICATION SCHEME

A Certification Scheme is a set of rules, procedures, and application management for carrying out the certification of specified products, to which the same specified requirements, specific rules and procedures apply (2).

This set of requirements and rules are generally described in a document called "rule of certification" which includes in minimum:

- the scope of certification,
- the product requirements,
- the assessment procedure for the first awarding,
- the assessment procedure of the surveillance (including product characteristics and factory inspection and audit),
- the application dossier.

The stakeholders are also described (technical committee with end-users and prescribers, producers or service providers, technical bodies such as laboratories and inspectors …)

Product certification is the provision of impartial third-party attestation that fulfilment of specified requirements has been demonstrated. Product certification is carried out by product certification bodies which should accredited according to ISO/IEC 17065. Specified requirements for products are generally contained in standards and other normative documents. When standards are not available or precise enough, specific documents may be drafted.

Product certification is an established conformity assessment that provides assurance to consumers, regulators, industry and others that products conform to specified requirements, including for example product performance, safety, interoperability and sustainability.

Product certification can facilitate trade, market access, fair competition and consumer acceptance of products on a national, regional and international level.

The fundamental objectives of product certification are to:

- address the needs of consumers, users and all interested parties by giving confidence regarding fulfilment of requirements;
- allow suppliers to demonstrate to the market that their product has been attested to fulfil specified product requirements by an independent body.

Product certification has to provide confidence for those having an interest in fulfilment of requirements (e.g., reliability of the product specifications for the design of civil engineering works when the design of civil projects are under designers responsibility or insurance of inspection of the waterproofing and the resistance of the welds during the geosynthetics barriers installation) (2).

That is why the involvement of all stakeholders (consumers, users, suppliers…) are fundamental for the credibility of the certification scheme.

The French certification scheme of products and services includes:

- geotextile products and related products
- polymeric and bituminous geomembranes
- welding and construction site managing for the geomembranes installation

3 WHAT ARE THE PRODUCTS REQUIREMENTS AND THE INSPECTION OF THE CERTIFICATION SCHEME

3.1 *Geotextile products and related products certification scheme (3)*

The Technical Rule of Certification "Geotextiles and related products" defines requirements on the relative ranges of variation of the descriptive, mechanical and hydraulic characteristics linked to the declared functions (separation, filtration, reinforcement, drainage, protection), as well as the process for obtaining the certification:

- application review
- on-site quality system inspection for ensuring the reproducibility of the product's characteristics
- random sampling of two rolls of the candidate products
- tests of the sample in an independent and accredited laboratory
- presentation of the dossier for advice of the technical committee
- decision to grant the certificate

An unannounced inspection and sampling of the product is done within the 3 years, before the expiry date of the certificate.

The renewal procedure is the same as first application one.

The certification "Geotextiles and related products" ensures that the nominal values declared by the producer (NVDP) for the claimed functions fall within the Relative Range of Variation with a 95% of confidence level (RRV95) which corresponds to plus or minus a stated percentage of the NVDP required by the Technical Rule of Certification (cf. figure 1).

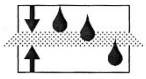
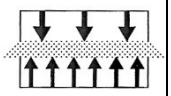
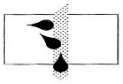
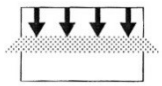
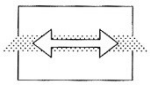
FUNCTIONS	Filtration 	Séparation 	Drainage Filtration 	Protection 	Reinforcement 
DESCRIPTIVE CHARACTERISTICS					
Nominal thickness	± 20 %	± 20 %	± 20 %	± 20 %	± 20 %
Mass per unit area	± 10 %	± 10 %	± 10 %	± 10 %	± 10 %
MECHANICAL CHARACTERISTICS					
Tensile strength	- 13 %	- 13 %	- 13 %	- 13 %	- 5 %
Tensile strength at 5%	not required	not required	not required	not required	- 20 %
Elongation at maximum stress	+ 23 %	+ 23 %	- 20 %	+ 23 %	+ 20 %
Dynamic perforation resistance	+ 25 %	+ 25 %	+ 25 %	+ 25 %	+ 25 %
Puncture test	- 30 %	- 30 %	not required	- 30 %	not required
Static puncture test	not required	- 10 %	not required	not required	- 10 %
HYDRAULIC CHARACTERISTICS					
Water permeability normal to the plane	- 30 %	- 30 %	- 30 %	not required	not required
Opening size	± 30 %	± 30 %	± 30 %	not required	not required
Water flow capacity in the plane	not required	not required	-30 % *	not required	not required
Compressive creep properties	not required	not required	- at 2 min -at 1 h - at 1008 h	not required	not required
Tensile creep	not required	not required	not required	not required	Voir annexe 3

Figure 1. Requirements of performance of the characteristics of Geotextiles

It is reminded that the certification scheme does not guarantee the suitability of the certified product to the technical constraints of the civil engineering project.

3.2 *Polymeric and bituminous geomembranes certification scheme (4)*

The Technical Rule of Certification "Geomembranes" defines requirements relating to physical, mechanical, hydraulic and physicochemical characteristics for geomembranes, as well as the process for obtaining the certification:

- application review
- on-site quality system inspection for ensuring the reproducibility of the product characteristics
- random sampling of two rolls of the candidate products
- tests of the sample in an independent and accredited laboratory
- presentation of the dossier for advice of the technical committee
- decision to grant the certificate

An ongoing revision of the Technical Rule of Certification will include a weldability test and an inspection of samples from the open market.

The certification "Geomembranes" ensures that the nominal values declared by the producer (NVDP) of its products fall within the Relative Range of Variation corresponding to a 95% of confidence level (RRV95). This RRV95 corresponds to a plus or minus stated percentage of the NVDP required by the Technical Rule of Certification (cf. figure 2).

Family of product (material)	**PVC-P**	**PEHD**	**PP-F**	**EPDM**	**BITUME**
PHYSICO-CHEMICAL CHARACTERISTICS					
The physico-chemical characteristics of polymeres are inpected during the audit and tested.					
PHYSICAL CHARACTERISTICS					
Functional thickness (mm) - Smooth (average value) - Non smooth (average value) - Minimum individual value	 0/ +6 0/ + 15 - 5	 0/ +6 0/ + 15 - 5	 0/ +6 0/ + 15 - 5	 - 5/ +5 - 5/+ 10 - 10	 0/+ 15 0/ + 15 - 10
Mass per unit area	0/+6	0/+6	0/+6	0/+5	0/+15
MECHANICAL CHARACTERISTICS					
Static puncture - strength at maximum force - strength at maximum displacement - yield strength - displacement at yield	 - 10 - 15 - -	 - 10 - 15 - -	 - - - 10 - 15	 - 10 - 15 - -	 - 10 - 15 - -
1 – Tensile strength: - at 15 % of elongation - at 50 % of elongation - at maximum stress - at 250% of elongation 2 – Elongation at the maximum stress 3 – Yield point strength 4 – Yield point elongation	 - 10 - - - 15 - - -	 - - - - 10 - - 10 ± 15	 - 15 - 15 - - 15 - - -	 - 10 - - - 15 - - -	 - 25 - - 25 - - 20 - -
HYDRAULIC CHARACTERISTICS					
Water permeability	Flow < 0,1 l/j/m²				

Figure 2. Requirements of performance of the characteristics of HDPE Geomembranes

It does not guarantee the suitability of the certified product to the technical constraints of the project.

3.3 *Welding and construction site managing for the geomembranes installation certification scheme (5)*

The Technical Rules of Certification "Application of Geomembranes" defines requirements for the installation of geomembranes involving the welding of geomembranes. Welding is defined by all the operations of preparation, adjustment of welding machines, assembly of geomembranes, control and realization of singular points (mechanical fixings for example).

This certification process includes:

- the inspection of the knowledge and skills of the welder about the geomembranes and the “state of the art” of the welding,
- the welding equipment, its calibration and use,
- the on-site self-inspections of the quality of the weld.

This examination is led by a specialized assessor. The resistance of the welds is tested in an independent laboratory if the assessor evaluated the practical examination as conform to the requirements of Technical Rules of Certification.

The construction site managing service includes the ability of the site manager to:

- Supervise of one or more teams,
- Take decision(s) relating to the site(s) managed,
- Represente the company on the site(s) managed,
- Management the internal quality control of the site(s).

Three dossiers of end of construction review and inspection (as-built records) are evaluated by the assessor on:

- Support and material receipt sheet,
- Weld inspection sheets checked by the site manager,
- As-built plan,
- Nonconformities,
- Human resources (nominative list) and materials
- File of following interventions on works.

4 ADDED VALUE OF THE USE OF THE CERTIFICATE FOR THE MANUFACTURERS/SERVICE PROVIDERS, ENGINEERING AND DESIGN OFFICES AND THE MAIN CONTRACTORS

4.1 *Manufacturers and service providers*

The main benefits of a certification process is to:

- Simplify the approach and reduce the costs (non conforming products, quality control)
- Homogenize the practices and optimize the internal functioning thanks to corrective actions
- Develop the skills of the employees and involve them in a common project
- Have a competitive advantage to increase the competitiveness and access to new markets

4.2 *Engineering and design offices and main contractors*

The Relative Ranges of Variation have been set by knowing better and better the measurement uncertainties related to product, manufacturing of the product, testing methods which have impacts on the reproductibility of the product characteristics.

These characteritics are measured in an ISO 17025 accredited laboratories which are regularly inspected by an accreditation body for the application of the normative test method.

The certification body is ISO 17065 accredited. Those two accreditations warranty the independence of the laboratory and the certification body, their competence, the consistency of the tests realised and the process of certification and their impartiality (6).

The certification laboratories, such as the manufacturer laboratory join to annual robin tests to improve the accuracy of the measurement of the product characteristics.

The certification raise the confidence in the product characteristics for the design of civil engineering construction thank to the level of control done during:

- The audit of the factory with a “specific product orientation” and “risk analysis” on the characteristics of the product at each step of the manufacturing of the product, from the purchase of the raw materials to the delivery of the labelled finished product,
- The continual improvement of the product characterisation by working on a better knowing of the product and the production process, the test methods and the skills of the laboratories in charge of testing the products, listed on the “Test Method Collection”. This Test Method Collection allow to precise vacant parameters on a testing standard which may impact a result of characterisation without changing the test standard and reduce the uncertainties related to testing methods,
- The yearly robin test on geotextiles including both accredited laboratories for the certification and producers laboratories accurate the product characterisation.

The positive impact of the service certification on the reduction of the non-quality costs from 20% in 1970 to 5% in 2010 of the cost of civil engineering construction project where the tightness was an issue. The confidence in the welding and site managing services of the tightness of civil engineering construction has been explained with the development of the certification in this sector by a study done by a French construction project manager (7).

The DIRECTIVE 2014/24/EU of 26 February 2014 on public procurement states (8):

- Article 43. Label: 1. Where contracting authorities intend to purchase works, supplies or services with specific environmental, social or other characteristics they may, in the technical specifications, the award criteria or the contract performance conditions, require a specific label as means of proof that the works, services or supplies correspond to the required characteristics
- Article 44. Test reports, certification and other means of proof: 1.Contracting authorities may require that economic operators provide a test report from a conformity assessment body or a certificate issued by such a body as means of proof of conformity with requirements or criteria set out in the technical specifications, the award criteria or the contract performance conditions.

Thus, certification scheme offers a legal frame to secure the conformity of the needs expressed by the end users of the certified products.

5 CONCLUSION

The frame of the certification, including:

- the intervention of all stakeholders as in the drafting of the requirement than in the awarding of the certification,
- the systematic inspections and surveillance,
- the managing of the claims from end users of certified products,

provides a strong tools for making more reliable and confident the products and services having been certified under an accredited Rules of certification.
The corrective/security factors can be reconsidered when the product's characteristics are more reliable during the phasis of design of civil engineering works on the basis of the product characteristics.
The durablity of the construction works is more reliable when the products have been installed by a service provider which has been certified for its ability to work in the state of the art.
The involvement of all stakeholders keeps on being one of the major condition to get robust and usefull crtification scheme.

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