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The PE100+ Association

Ensuring the highest quality in the PE 100 pressure piping material

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The PE100+ Association

Ensuring the highest quality in the PE 100 pressure piping material

Founded on February 24, 1999, the PE100+ Association is an industry organisation of several polyethylene (PE) manufacturers whose objective is to guarantee consistent quality at the highest level in the production and use of PE 100 pipe material. By monitoring the most critical properties of enhanced requirements, the Association is able to issue a "PE100+ Association Positive List of Materials" on a regular basis. The Association also aims to create a marketing platform to promote the use of PE piping in general.

The use of plastics in gas and water distribution

At the beginning of the gas industry in the last century, only metals were used for piping. Their use started with grey cast iron followed by nodular iron and mild steel up to high performance steel today. Plastics were first used in the US where various studies were carried out, resulting in networks in different types of plastics: ABS, PVC, PA, and PE. Of all the tested, evaluated and used plastics for gas distribution, not taking into account a few exceptions, only polyethylene has been retained with very good results, thanks to its exceptional resistance against all sorts of failures that might happen in the field, including absence of brittleness and corrosion. Additional advantages make PE pipe an excellent choice:

- ▷ Ease of handling thanks to flexibility and light weight
- ▷ Leak-tight installation thanks to excellent fusion-welding possibilities

- ▷ Long life with low operational costs
- ▷ Capability for relining existing pipelines
- ▷ Chemical resistance

In water distribution, which started more than one millennium ago, the range of materials is even more wide, ranging from metals or wood, over all sorts of brick and ceramic materials to, more recently, plastic materials. Today, both plastic and non-plastic materials are used and the actual choice depends upon the local situation. However, it is clear that both polyvinylchloride (PVC) and polyethylene (PE) have taken important parts of this market. At first, the use of polyethylene was limited to low pressures, both in gas and water distribution. At the end of the eighties, PE 80 was the standard material for such applications, especially in the lower diameter range.

The introduction of PE 100 compounds offered gas and water engineers an excellent opportunity

The introduction of PE 100, about one decade ago, enabled end users to extend the advantages of the well-known PE 80 beyond the technical or economical limits they were faced with. Indeed, gas engineers were looking for a type of polyethylene that would be able to withstand pressures of above 4 or 5 bar in all safety, without risking rapid crack propagation (RCP). PE 100 offered this possibility and end users such as British Gas (UK) and Electrabel (B) used this new material almost immediately for their medium pressure gas distribution (5-7 bars). Other countries followed later on and PE

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100 is being used for pressures up to 10 bar in natural gas distribution today.

Water engineers were continuously looking for large diameter polyethylene pipes withstanding higher pressures or having greater hydraulic surfaces. They used the 25 % higher long term strength offered by PE 100 to reduce wall thickness or to increase pressure rating, thus enabling more economical solutions to their problems than ever before.

Quality insurance for PE 100 pipes

PE 100 is a well-established pipe material, offering reliable operational performance under extreme loading conditions. To guarantee the material's high performance standard, strict quality control tests must be adopted. A whole range of end-user specifications, as well as both national and international standards determine the requirements that have to be met by PE 100 materials today. These will shortly be replaced by new and binding European Standards that will constitute a uniform, pan-European basis of minimum requirements. However, these

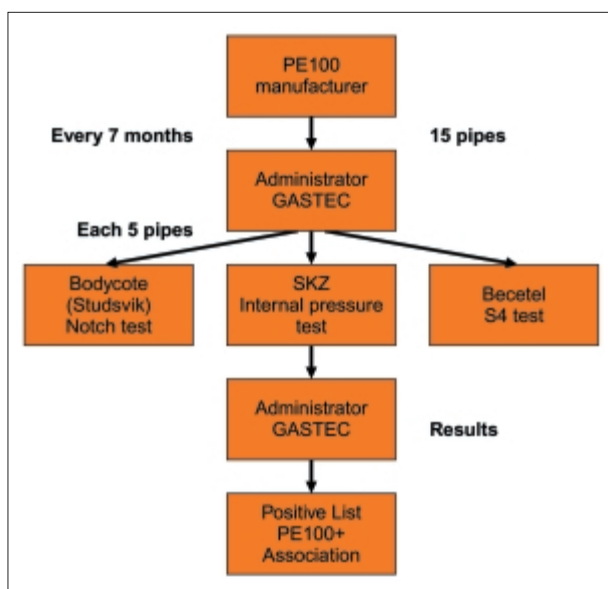
Picture 1: Don't crack under pressure; The PE100+ Association



don't crack under pressure

Property	Test Method	EN/ISO Standard requirement	PE100+ requirement
Creep Rupture Strength	Internal pressure test at 20°C and 12.4 MPa ISO 1167	≥ 100 h	≥ 200 h
Stress Crack Resistance	Pipe notch test at 80°C and 9.2 bar ISO 13479	≥ 165 h	≥ 500 h
Resistance to Rapid Crack Propagation	S4 test at 0°C ISO 13477	$P_c \geq \frac{MOP}{2.4} - \frac{13}{18}$ <small>P_c: critical pressure MOP: max. operat. pressure</small>	≥ 10 bar

Picture 2: PE100+ requirements compared with European Standards



Picture 3: PE100+ Testing schema

Standards are, in fact, based upon a series of compromises, the result being minimal performance requirements and, specifically, no systematic material quality control is mandatory. With the aim of offering a "safety plus" by raising the performance requirements of PE 100 compounds above those demanded by future European Standards (CEN), three leading PE manufacturers took the initiative to

- ▷ A high degree of long-term Strength (Creep Rupture Strength)
- ▷ Excellent resistance to Slow Crack Growth (Stress Crack Resistance)
- ▷ Good behaviour in Rapid Crack Propagation (Resistance to Rapid Crack Propagation)

All tests are performed on 110 mm SDR 11 pipes. **Picture 2** shows the PE100+

Table 1: Positive list

Product	Manufacturer
Finathene® XS10 H (blue)	ATOFINA
Finathene® XS10 B (black)	ATOFINA
Hostalen® CRP 100 black	Basell Polyolefine GmbH
Hostalen® CRP 100 blue	Basell Polyolefine GmbH
Hostalen® CRP 100 orange/yellow	Basell Polyolefine GmbH
Borstar® HE3490-LS (black)	Borealis AB
Vestolen® A 6060 R (black)	DSM Polyolefine GmbH
ELTEX® TUB 121 (black)	Solvay Polyolefins Europe
ELTEX® TUB 125 N2025 (orange)	Solvay Polyolefins Europe
ELTEX® TUB 124 N2025 (blue)	Solvay Polyolefins Europe

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join together and form the "PE100+ Association". The PE100+ Association was launched at the 24th of February 1999 by polyethylene manufacturers Basell, Borealis and Solvay Polyolefins Europe SA. Further members are Atofina, as a fourth member joined the Association in 2000, and DSM as the fifth member early 2001 [1].

Technical background

On the «quality» level, the PE100+ Association bases its material acceptance on the ISO and CEN Standards: the relevant materials to be tested must conform to EN 1555-1 and ISO 4437, or EN 12201-1 and ISO 4427. To comply with these, fully documented data sets must be provided demonstrating a long-term strength of at least 10 MPa at 20 °C over a period of 50 years according to ISO 12162 [2].

The PE100+ Association also organises regular controls on three critical properties, which ensures the secure operation of PE 100 pipes. These three properties are:

requirements compared with European Standards.

In addition, the PE100+ Association aims to set higher performance targets for these three properties than those which will become the norm in future CEN Standards for the following reasons:

- ▷ PE 100 products are designed for higher pressure operation in gas applications. Performing tests on the Rapid Crack Propagation (RCP) behaviour of such materials guarantee a safe operation of the pipeline. PE 80 products have demonstrated that for many years.
- ▷ By performing creep and notch tests, we assure that we take both possible failure modes of PE pipe material into account: deformation and ageing (SCG - Slow Crack Growth). In order to have a quick estimation of this SCG phenomenon on PE pipe material, a design lifetime of 50 years is shown by the regression curve. This is demonstrated via the so-called pipe notch test, which uses two acceleration factors, high temperatures and artificial stress concentration. The pipe notch test is performed on V-shaped notched pipes.

The testing layout and schedule

All tests are performed on 110 mm SDR 11 pipes. In accordance with the scheme shown in **Picture 3**, independent laboratories carry out the tests at seven month intervals under supervision of Gastec, an internationally recognised testing institute.

The PE100+ Association publishes the "PE100+ Association Positive List of Materials" showing the materials that successfully meet the PE100+ requirements. In order to keep the "safety plus" objective of the PE100+ Association, only materials

which are controlled regularly can be part of that positive list. In addition, materials have to pass two successive test rounds in order to be listed, thus not only ensuring quality control, but quality consistency as well. The current positive list (**Table 1**) is published on the Associations web site.

Marketing issues

The purpose of the PE100+ Association is not only to guarantee high and constant quality, but also to be active on the market in the promotion of PE pipes in general and PE 100 pipes in particular. In practice, this is done via two main tools: a website and a series of seminar rounds [3].



Picture 4: PE100+ seminar round in Spain

PE100+ Web Site

Together with the launch of a new corporate design, the Association's web-site was launched featuring its principal corporate colours - dark blue and orange (www.PE100plus.net). Both colours stand for the innovative PE products mainly targeted towards the gas and water industry. Currently, the website provides general information about the Association, including a FAQ and Q&A section. Communication material, recently held presentations and the Association's leaflet are available from the download centre. The current "PE100+ Association Positive List of Materials", being the most important publication, is directly accessible on the entry page.

Seminar Rounds

The PE100+ Association has gained sufficient feedback from the market to know that there is still some work to be done in convincing end-users, mainly water companies, about the benefits of PE (100) Pipe systems. Therefore, the Association continues to organise seminars in different countries. The purpose of these seminars is to provide the technical background to PE pipe systems, to explain the difference between PE 80 and PE 100 and finally to show relevant case studies. These case studies are ideally presented by an already convinced end-user. Speakers drawn from the whole industry also cover overall topics such as welding and tracking of installed pipes. Previous seminar rounds were held in

Germany, Austria, Switzerland, Poland, France and recently Spain (**Picture 4**). Our aim is to continue organising such seminars in the forthcoming years and to ensure follow-up on previous seminars [4].

Advisory Committee

To be in line with the market, it is important for the Association to get feedback. This is why the Association has an Advisory Committee. Meetings of this board have been held on several occasions, and subjects discussed have graduated from "why such an Association is useful" and "how to position such an Association" at the very first meetings to more in-depth discussions about PE 100 pipe systems and their technical and economical value at subsequent meetings.

The PE100+ Association is open to any manufacturer whose materials comply with our enhanced requirements, and who is able to produce consistent compound quality according to ISO 9000 standards.

More information can be obtained at the following address: PE100+ Association, c/o Gastec, Wilmersdorf 50, NL-7327 AC, Apeldoorn, the Netherlands and under contact@pe100plus.net; www.pe100plus.net

Literature

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