aquatechnik® australia

multi-calor ®

Multi-layer Pipes

aquatechnik® australia

The pipe used in the **multi-color** system is made by integrating different materials, resulting in the terminology “multi-layer”. The polymer of the internal/eternal layer is crosslinked polyethylene (PE-X, see table of values and features). This produces pipe with very good performance with high temperature fluids under pressure and leaves the characteristics of potable water unchanged. During the production process, the external cover of the pipe (PE-X) is combined with thin aluminium alloy layers, welded lengthwise – by laser beam plasma – and then combined with a special adhesive to make the materials bond perfectly. The result is that the metal (Al) is covered by a PE-X layer, protecting it from corrosion. All the process stages are checked by computerised quality control ensuring every batch meets the appropriate standards.

The **multi-color** pipe range is certified by regulatory authorities and complies with the laws in force for the conveyance of potable fluids for human consumption in countries including Italy, Germany, Spain, the Netherlands, Norway, Poland, USA, France, Russia and Australia.

Crosslinked polyethylene

In the crosslinking process, the polymer chains undergo a reaction that creates very strong links between them thus modifying the chemical, physical and mechanical properties of the polyethylene. As compared with high density polyethylene (PE) or polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X) guarantees greater performance, among which the most important feature is long term resistance to ageing and to high temperatures. Crosslinked polyethylene can be produced by using different technologies recognized by International Standards and identified by the methods A (peroxides), B (silanes), C (radiation), D (azocompounds); the method used is indicated together with the abbreviation for the material, thus obtaining PE-Xa, PE-Xb, PE-Xc, PE-Xd.

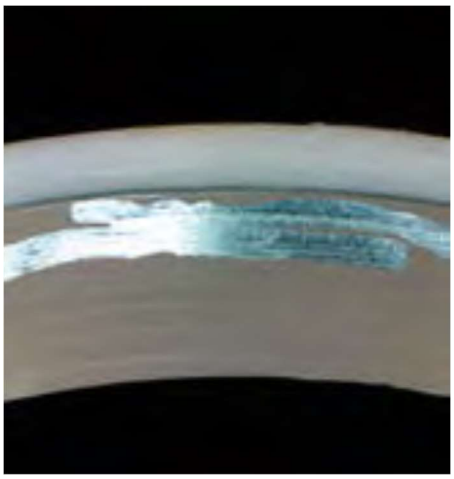
There is much conflicting information in the market as to which is the best technology; however, it is not the type of crosslinking process that determines the quality of the pipe but the capacity to produce it in compliance with all the relevant quality standards which are applied to all four of the above-mentioned crosslinking methods.

The polyethylene that composes Aquatechnik multilayer pipes is crosslinked PE-Xb by means of the admission of steam at 100°C inside sealed chambers in which the product is placed. A level of vacuum is created in the chambers such as to guarantee that the steam entering the chamber completely penetrates each single coil thus ensuring a uniform level of crosslinking regardless of the diameter and the length of the pipe. It is an innovative crosslinking process as compared with traditional crosslinking methods such as soaking or water circulation and ensures extreme homogeneity of the mechanical characteristics of the finished product.

The aluminium forming process

There are different methods to produce multilayer pipes, and they differ mainly in the technology used in forming the aluminium pipe. It can be formed by overlapping, overlapping and welding, or by butt connection and welding. The latter is the technology chosen by Aquatechnik in that it guarantees a uniform thickness across the entire circumference, greater resistance to pressure and bending, uniform mechanical characteristics, greater adhesion values with the bonding layers and a total barrier to oxygen.

1



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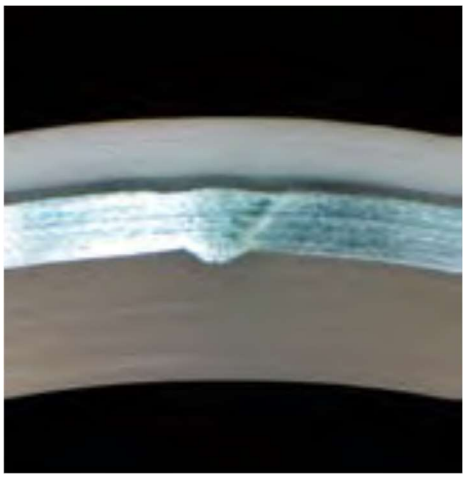

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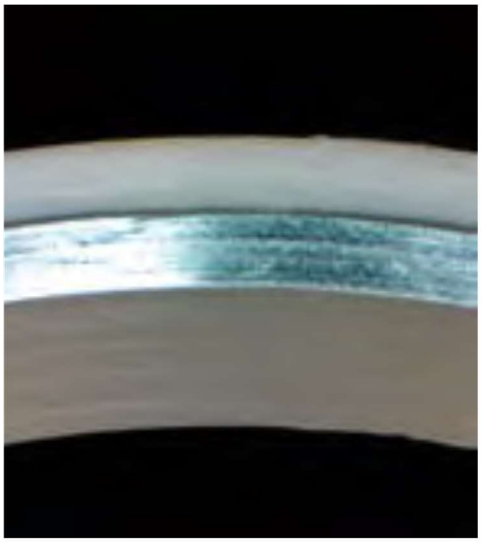


Figure 1 Welding by overlapping - Figure 2 Butt-welding - Figure 3 **Aquatechnik** butt-welding

The Aquatechnik water distribution system was designed to facilitate installation and increase functionality: one type of pipe allows the installation in multiple fields as all the plant-engineering systems.
HOUSING: hot and cold potable water; heating systems; conditioning and cooling systems;
garden irrigation; distribution networks; sanitary systems.
INDUSTRIAL: hot and cold potable water; conditioning and heating systems; compressed air;
supply to machinery pneumatic and hydraulic circuits; marine; agriculture; greenhouses; sanitary systems and other applications compatible with the basic material.
SERVICE INDUSTRY: hot and cold potable water; shops; laboratories; surgeries; schools; gym and
swim centres; restaurants, public premises; religious buildings; animal care and breeding centres; etc.

With the multi-layer pipe, the typical advantages of metal pipes are added to those of plastic pipes and at the same time the positive aspects of one material compensate for the defects of the other. The negative aspects of metal such as: corrosion, toxicity, deposits, rigidity, weight, elevated pressure losses are neutralised by the pipe in PE-X that comes into contact with the fluid. The negative aspects of plastic, such as: low barrier to gas and UV rays, elevated heat expansion and instability, are overcome thanks to the aluminium pipe.

Thanks to the exceptional physical, chemical and mechanical properties of **multi-color** and **safety** system, makes it ideal for applications in marine environments. Installations can be made in direct contact with sea water without compromising performance in any way. The **multi-color pipe** is the ideal solution for installations in the presence of strong salt concentrations, placing it among the most widely used systems in the marine industry.

Resistance to abrasion, deposits and corrosion

The internal layer in PE-X is not subject to corrosion and deposits. The surface is not corroded and therefore there is no risk of rust particles or lime scale resulting from galvanic corrosion. PE-X is particularly resistant to abrasion. This property is very important, especially in bends, where the abrasive action of the impurities present in the water is amplified, above all when the flow rate of the water is particularly elevated.

Mechanical behaviour

The bending radius can vary from 2.5 to 5 times the diameter of the pipe and the section of the bend remains constant. The pipe, once bent, remains in the desired position just like a metal pipe. It is therefore possible, when systems need to be installed in series, to prepare pipe sections in advance with the fittings pre-fitted and to bring them to the building site already assembled. The malleable features of the pipe enable bends with a very narrow radius to be formed. If pipes of a lager diameter need to be bent, or a very tight bend is required, then pipe benders will be required.

Elongation

The thermal expansion (0.026 mm/m°C) takes on values very close to the thermal expansion of metal pipes.

Oxygen barrier

The aluminium pipe forms a perfect barrier to gas molecules thereby avoiding corrosion hazards due to oxygen penetration and damage as a result of exposure to UV rays.

Smoothness

The internal layer of the pipe has a smooth surface (roughness 0.007 mm) and is free from lime scale and rust deposits. The losses in pressure are therefore very low and remain constant over time which represents a very important aspect.

Performance when exposed to fire

The pipe does not burn easily thanks to the intermediate metal layer. The density of smoke produced is very low and the emissions produced are not toxic.

Lightweight

The specific weight of the components of the pipe are significantly low. A coil of 100 mt. of 16x2.25 weighs approx. 13 Kg.

Durability

If used at the pressures and temperatures indicated (pressure up to 10 bar, maximum operating temperature of 0-95°C, for the operative temperatures see the tests), the materials will possess a very elevated ageing resistance. Artificial laboratory ageing tests guarantee the pipe a working life of over 50 years. At working temperatures below 95°C, the pipe will withstand pressures of over 10 bar without undergoing damaged (up to 25 bars with temperatures of 20°C).

Degree of hygiene

The system is used in every type of installation without any drawbacks. Non-toxic materials are used for the pipes and fittings and can be used to distribute drinking water.

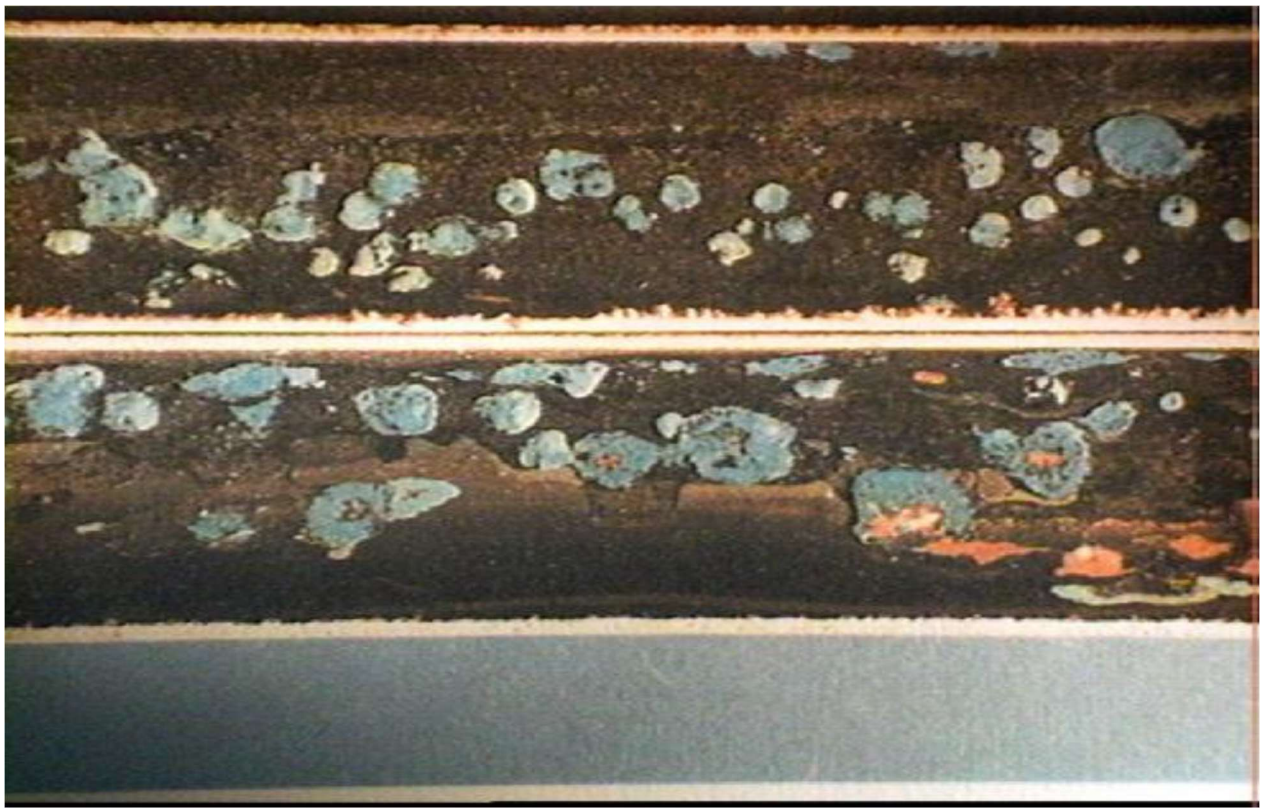
Thermal conductivity

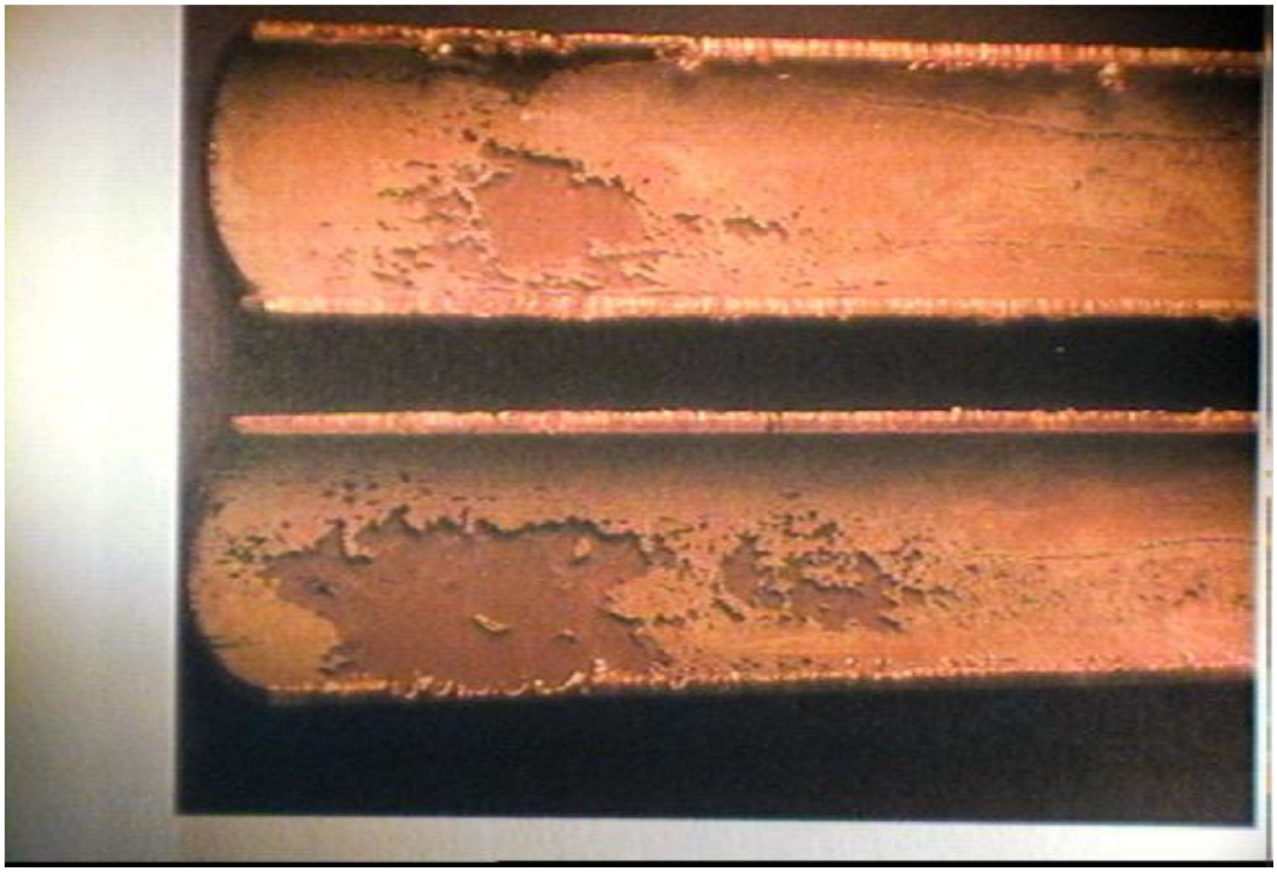
The thermal conductivity of the pipe is 0.43 W/m.K., that is, very low. The heat loss is approximately 900 times lower as compared with copper.

Acoustic absorption

The acoustic insulation properties of the pipe are very good. The internal and external layer in PE-X attenuate the noises that normally would not be absorbed by metal pipes.

INSIDE COPPER PIPE CORROSION





INSIDE STEEL PIPE CORROSION

Quality Control

In the Aquatechnik factory, the entire production process of the multi-layer pipe undergoes continuous and strict quality controls. As well as the numerous tests requested by the protocols published by the most important international certification institutes, Aquatechnik carries out important tests of a high qualitative value on its products.

Dimensional aspect

The principal test performed on the **multi-color** pipe is to measure the diameters and the thickness of the individual layers; this test is performed in the laboratory with the help of the most technologically advanced optical measurement equipment, complete with software capable of automatically carrying out the dimensional tests (the dimensions of the pipe are tested in the process using laser detectors). The sophisticated optical projector also enables the weld cross-section to be checked and therefore to verify that the weld has been correctly carried out.

Separation test

Of equal importance is the separation test. This is performed using a computerised dynamometer capable of assessing the force required to separate the aluminium layer from the internal pipe (glued together). As a result, the test provides a graph describing the value of the force (at every point on the pipe's circumference) to be applied to separate the layers; the adhesion between the PEX and the aluminium is fundamental for the seal of a multilayer pipe under pressure: the greater the adhesive strength, the greater the pressure the product can undergo.

Bending test

The 90° bending test is one of the mechanical tests performed on the **multi-color** pipe. This test is performed using a dynamometer that records the force required for bending.
The test is passed if no squeezing or wrinkling of the external layer occurs on the test specimen.

Estimation of the degree of crosslinking

The finished **multi-color** pipe (which has already completed the cross-linking process) is subjected to a test that measures the degree of cross-linking achieved by the polymeric materials. The testing procedures are defined by international standards and are strictly followed by the operators assigned to perform the test; the degree of cross-linking of the polymers is used to assess the aggregation of the material's molecules and it is therefore important for assessing the increase in the mechanical and chemical resistance of the polyethylene.

Pressure test

Throughout the daily production of the **multi-color** pipe, sample of pipes are selected (at pre-established intervals) and are subsequently tested at 95 °C at specific pressures for each product. The tests are designed to ensure the product is suitable for sale and to evaluate its hydraulic, mechanical and structural characteristics. The tests are performed in special tanks or ovens at electronically controlled temperatures. The pressures set at the inlet of each sample and the test conditions are controlled and recorded step by step by a computerised system and were established during the certification of the product.

Long duration tests

The long duration tests are carried out to confirm the reliability of the product over time. In fact, they are carried out for 1000 hours both at 95 °C in special tanks, and at 110 °C in special ovens.

Cone test

Samples of **multi-color** pipe taken during the production phase at regular intervals undergo the cone test; this test is performed in compliance with international standards, and is carried out on-line by the production operators and in the laboratory by the Quality operators (in this case the test is performed using a computerised dynamometer); this test is designed to assess the seal of the weld and the sealing strength of the glue applied between the various layers, after having expanded the pipe by more than 13% of its nominal diameter.

Dimensional test during production

The diameters of the pipe are constantly monitored by laser instruments during the production of **multi-color**, supported by a computerised system in the successive phases of the manufacturing process; in this way the production operators are able to observe the trend graphs of the individual diameters on the line monitors at every moment; appropriate alarms are activated when the values lie outside the preestablished range.

Tensile test

The fundamental raw material for the production of the **multi-color** pipe is aluminium; in order to avoid defects in the supply of this material (even with top quality suppliers) Aquatechnik carries out tests on each delivery by measuring the dimensions and mechanical characteristics; the mechanical properties are verified by carrying out

tensile tests (established by international standards) on samples of material randomly selected from the batch that has been delivered; the tests are carried out with the use of sophisticated computerised dynamometrical instruments.

Analysis of melt flow index

All of the polymerical raw materials utilised in the manufacture of the multilayer pipe are controlled on arrival in order to verify their principal characteristics; this allows Aquatechnik to produce with the certainty of employing materials suitable for manufacturing; the instruments utilised for the controls are the most technologically advanced available: for example, the melt flow index measurement is taken with the use of the most up-to-date automatic appliances.

Heat resistance test

The controls carried out by the Aquatechnik quality control laboratories on the polymerical materials employed in the production of the **multi-color** pipe, do not end with the controls carried out on in-coming materials but continue after the production phase; the shrinkage and sliding test are carried out on the finished product on the various layers of polyethylene; pieces of pipe undergo artificial ageing tests and thermal stress tests in thermostatic cells.

Suitability of internal diameter (Marble Test)

Along the production line each and every coil of **multi-color** pipe is tested by introducing a steel marble into the pipe itself with the use of compressed air. This operation ensures the absence of collapses in the wall or obstacles inside the pipe.

Pipe hammer

At each production start-up of the **multi-color** pipe and the plastic fittings in PPSU (Polyphenyl Sulfone) a pressure cycle test is performed at 23°C. This consists of creating sudden pressure changes (frequency = 30 cycles per minute) inside the test specimen ranging from the lowest value (0.5 bar) to the highest value (25 bar) for 10,000 times with the aim of verifying the mechanical stability of the product and consequently the complete absence of leaks.

Vibration test

At each production start-up of the **multi-color** pipe a vibration test is performed: this consists of subjecting a 2 m long specimen, obtained by combining two 1 mt long pipes each with an intermediate fitting, to a combination of static pressure (15 bar) and vertical mechanical stress of misalignment (about 10 mm) with the aim of verifying the pipe-fitting compatibility or more precisely the absence of withdrawing. Each pipe-fitting combination is subjected to a total of 330 cycles each lasting 80 seconds that are made up of 20 seconds of vibrations with a pause of 60 seconds.
The test is considered positive if there are no leaks or ruptures.