PE100+ Association

Why choose PE compounds for pressure pipe??

Simplicity or consistency

The simplest way for any polymer producer to operate is to produce natural pellets for a wide range of applications (including pressure pipes) and ship them to the transformers who add the coloured master-batch during the manufacture of the products.

So why do all the members of the PE100+ Association promote the use of fully compounded materials for pressure pipe manufacture?

Put simply – **using PE compounds for pipe production provides a level of consistency in pipe quality and performance that other processes cannot match.**

Durability of pipe systems

PE pressure pipes are designed for a long lifetime (in excess of 100 years) in the underground infrastructure. Indeed installing the pipe in the ground is the most expensive part of operation (typically 85 – 90% of the project costs) so the last thing a gas or water engineer wants to do is replace the pipes within their working lifetime.

This "Peace of Mind" demands consistent materials and products which can only be achieved if the carbon black or pigment and other essential additives are correctly dispersed in the polymer matrix.

Compound Approach

The PE compound approach has been successfully applied in Europe and lead to high penetration of PE in both gas and water distribution. In gas penetration levels are close to 100% and 70% of all new water pipes installed in Europe are produced from PE compounds.

European specifications are set at a high level and include all the key properties to provide a long leak free life. These requirements have now been adopted by the International Standards Organisation in ISO 4437 (2007) and ISO 4427 (2007) for PE gas and water pipes respectively. Because these requirements are high and pipe compounds are consistent it means that the minimum design factors can be set low at 2.00 for gas and 1.25 for water. This ensures high quality at an acceptable price for the pipe.

Recently published failure data from the UK (1) and Danish (2) water industry confirm that this quality approach is the right one – PE demonstrates the lowest failure rate for all materials used for water mains.

Natural and master-batch approach

In some countries including the USA and Japan natural PE polymers and master-batch methods are used to produce gas and water pipes. However these system require a completely different approach to the quality assurance system and different processing equipment than is used elsewhere in the world.

For example in the USA the polymer supplier recommends the appropriate master-batch and addition levels to meet the ASTM requirements. Pipe producers are then responsible for controlling additive addition levels and dispersion. To achieve this they will use extruders specially designed to give good mixing and dispersion – very different to the high output extruders developed by the European manufacturers and sold throughout the rest of the world.

Also in the USA the ASTM performance requirements for PE pipes are at a lower level than the European or ISO standards (lower stress cracking requirements and as yet no RCP requirements). In addition the design factor is higher which means that thicker walled pipes are used for a specific service condition.

In taking the natural and master-batch route many issues have to be considered:

i) If the natural PE material is a PE100 it does not mean that the pipe made from the natural PE and a master-batch is a PE100 pipe. In some countries we have observed LDPE or LLDPE carriers used to help disperse the additives which will inevitably reduce the 50 year strength of the blend.

ii) Similarly if the natural material passes the stress crack resistance of the PE100 specification the pipe may not as the same carrier material will reduce the stress crack resistance of the blend.

iii) Good dispersion of the pigment and additives is essential for long term pipe performance. It is particularly difficult to disperse 2 – 2.5% carbon black without large agglomerates using a standard single screw extruder. These agglomerates can provide an initiation site for a crack which can cause premature failure of the pipe (see fig.1).

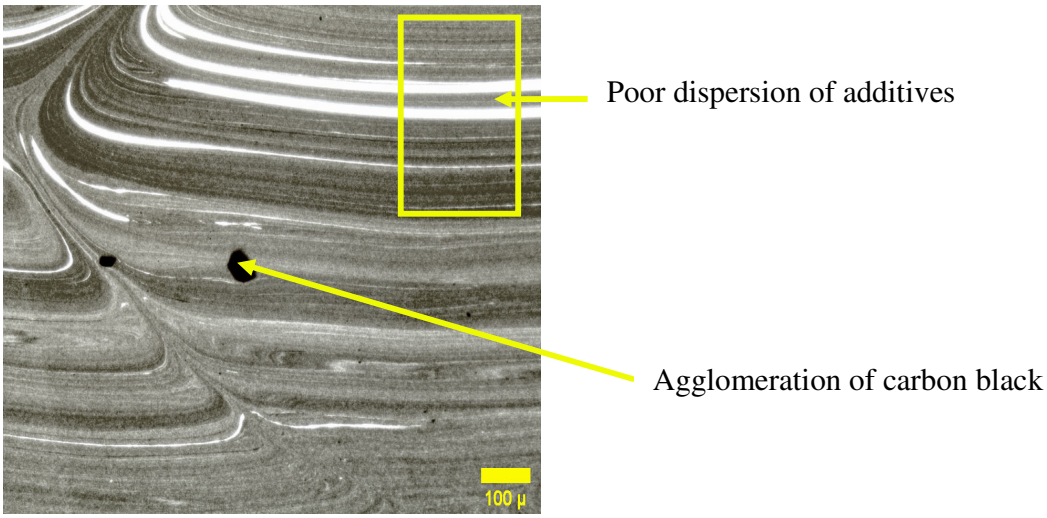

Fig.1. Poor dispersion of additives in polyethylene

iv) To reduce agglomeration we have observed that some pipe producers reduce the amount of carbon black but this means that the u.v. stability of the pipe will be sacrificed as a minimum level of 2% is required to protect the pipe over its lifetime.

v) Also to help improve dispersion and reduce costs some use a carbon black with a larger particle size. This will also reduce the protection of the pipe as a carbon black with a particle size below 25nm is required to achieve good u.v stability (3).

vi) The correct choice of additives also requires considerable knowledge and extensive testing to ensure that the finished product meets the long term performance requirements and the different organoleptic and food approval requirements around the world.

vii) Clearly using the natural and master-batch it is the pipe manufacturer who takes over the complete responsibility for the pipe quality since it is them that control all the above critical items.

Statement from PE100+ Association

Based on all the concerns detailed above the PE100+ association approach is based upon the exclusive use of **PE compounds** that has been so successful in gas and water systems in Europe.

PE pipe compounds are usually produced on line using specialised equipment during the pelletisation process. This creates a consistent raw material to be used for quality pipe production thus providing this important **"peace of mind"** for the network owner.

References

1) S. MacKellar, “Leakage survey in UK” Plastics Pipes XIII, Washington, 2006.
2) Fontenay, et al “Review of properties of pipe and fitting materials for drinking water”. Force Technology Report, 2005
3) S. Dougherty, “Technical and practical aspects of carbon black and masterbatch for pressure pipe”, Dubai Plast Pro, 2008.