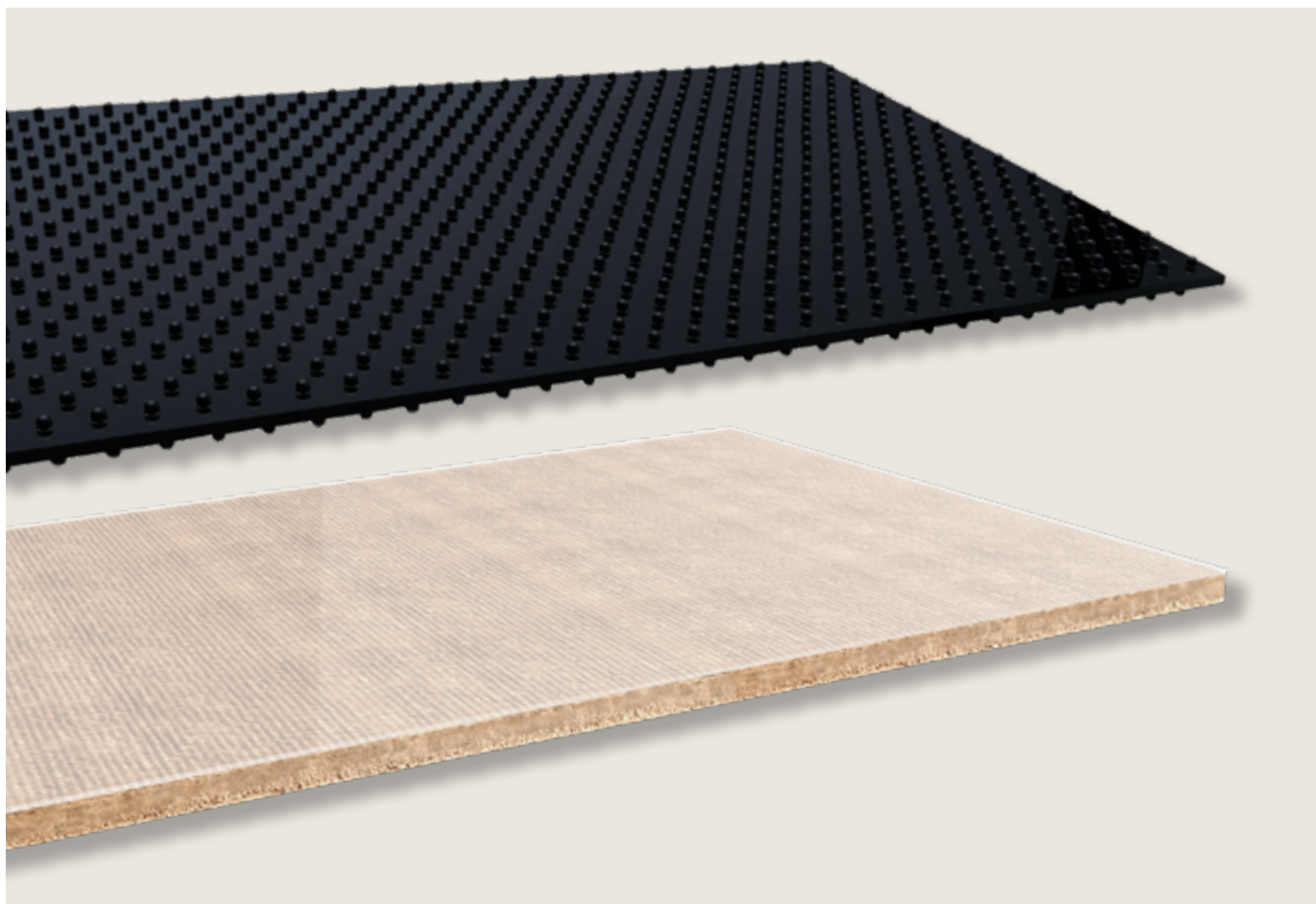


Carbofol®+ and Bentofix®+

Product types



Technical Note

What is new?

Naue GmbH & Co. KG launches a series of new types of Carbofol® and Bentofix® with a „+“ signature within the name. This „+“ indicates an extended oxidation induction time (OIT) and also an extended high-pressure oxidation induction time (HPOIT) in the membrane or polymer coating, respectively. The „+“ is marking our products as the best choice product wherever challenging conditions occur.

What is the reason behind it?

GM13 – which represents the „Standard Specification for Test Methods, Test Properties and Testing Frequency for High-Density Polyethylene (HDPE) Smooth and Textured Geomembranes“ by the Geosynthetic Research Institute, is widely used as a reference for specifications worldwide. Two central requirements of GM13 are OIT ≥ 100 min and HPOIT ≥ 400 min, and a residual portion of OIT or HPOIT must remain after oven ageing (ASTM D 5721).

OIT and HPOIT are indicative values that give information on the resistance of a polymer material against oxidation. While oxidation is known as the main reason for the ageing of polymers, the resistance against oxidation stands in close equivalency to the resistance against ageing. Even if the overall interrelation of external factors, material properties (e.g., the molecular structure of the raw materials) and the lifetime are quite more complex, an increased OIT / HPOIT extends the time before the polymer itself degrades. The following graphs from GRI Whitepaper #6 illustrate this.

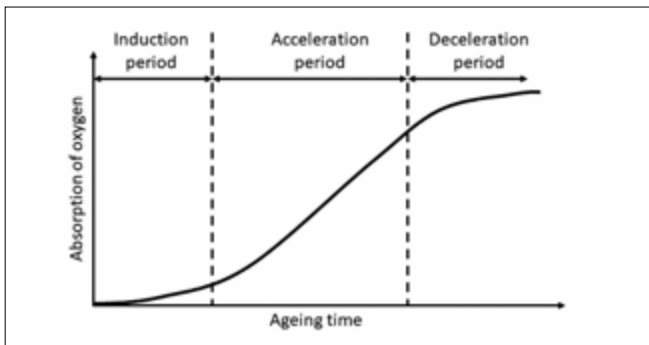


Figure 1: Qualitative progress curve of polymer oxidation – unstabilised polyethylene

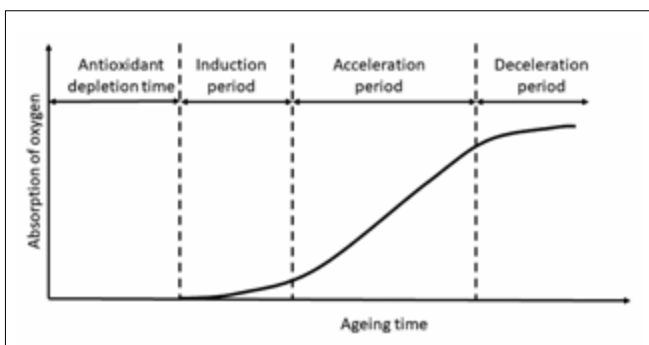


Figure 2: Qualitative progress curve of polymer oxidation – polyethylene with antioxidative stabilisation

GM13 declares in itself

„This standard specification is intended to ensure good quality and performance of HDPE geomembranes in **general applications**, but is possibly not adequate for the complete specification in a specific situation. Additional tests, or **more restrictive values for test indicated**, may be necessary under conditions of a particular application.“

An additional boost of oxidative resistance is especially relevant when aggressive chemical conditions or otherwise harsh conditions (e.g., long exposure to strong UV radiation) have to be considered. **These are usual conditions in mining applications.**

In conclusion, there is a push by responsible designers and authorities towards adding more oxidation resistance to geomembrane products, **especially in mining projects**, where conditions are usually most challenging for polymer components.

At the same time, the additional stabilisation of the polyethylene may not be to the disadvantage of mechanical properties that our geosynthetics are preferred for, such as ductility and – in terms of the geomembrane – the weldability.

Naue GmbH & Co. KG has developed a material composition that fulfills all the above requirements, increasing both OIT to 200 min **and** HPOIT to 600 min – as well as allowing for the required values of OIT **and** HPOIT to be present after oven ageing.

What are the specific products?

- Bentofix® + X5F NSP 4900
- Bentofix® + X10F NSP 4900
- Carbofol® + 406 2,0 7,5 s/s GM13 MT
- Carbofol® + 406 2,0 7,5 BF/TF GM13 MT

What is the benefit?

The clients will benefit from the safety of additional resistance to polymer oxidation (and – as explained previously – an additional lifetime before the polymer is attacked) **that elevates Carbofol® and Bentofix® „+“ products over such that are according to „normal“ stabilisation requirements (such as GM13).**

This can also help in sensitive projects where the planning process is hampered by concerns regarding the durability and persistence of the important barrier materials. Carbofol® and Bentofix® X „+“-types give an instrument to designers that allows them to communicate: „Yes, we acknowledge these concerns and add some safety by increasing the oxidation resistance“ – without discarding or rescheduling the project at immense costs.

Another benefit of having persistent OIT **and** HPOIT as polymer stabilisers over „classic GM13“-requirements is that the resilience against more different attacks (acidic and basic conditions, UV exposure...) is increased when combining the strength of both stabiliser packets instead of fulfilling only one individual parameter (OIT or HPOIT). This is of high significance, for example, in mining applications, where the type of chemical attack strongly depends on the process used for specific minerals.

