BTO *Executive Summary*

Follow nanotechnology developments, but focus on PE production improvement for the control of regrowth on pipe materials

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Nanotechnology offers new opportunities to improve the properties of materials by modifying material structures at the molecular or atomic levels. The modification of the surface structure of pipe materials could over time make it possible to reduce the regrowth potential of drinking water pipes, but there are as yet no ready-to-use solutions available for this purpose. There remain too many knowledge gaps concerning safety, regulations, effectiveness, costs and lifespan, to point to a nanotechnology development that is usable. At this time, there are probably easier ways of improving the regrowth properties of (PE) pipe materials than through nanotechnology; for example, by making modifications to the production process. Preference should be given to the joint pursuit of the latter course, while following developments in nanotechnology in a passive manner for the time being.

Participants at the 'Nanostructures on pipe walls to control regrowth' workshop, on 11 September 2018 in Nieuwegein.

Interest: possible reduction of regrowth potential on pipes

Nano- and microtechnology makes it possible to manipulate material structures at the molecular or atomic level, and thereby change the macroscopic properties. Nanotechnology has already produced basic new insights and applications, for example, in electronics, medicine and food technology. Perhaps nanotechnology can also contribute to reducing the regrowth potential on pipe walls in drinking water distribution networks.

The growth of microorganisms on pipe walls can lead to a deterioration of the microbial water quality and to problems with the water's coloration or odour. This exploratory research, within the Joint Research Programme, on the application of nanotechnology at drinking water utilities focused on the practicability of the introduction of nanotechnology, and on follow-up steps which could bring its possible application within reach.

Approach: literature study, research on framework conditions and workshop

The research took a broad approach, which incorporated the perspectives on a possible future development process of the different stakeholders: water utilities (the end-users), producers and manufacturers of water pipes, and scientists. A literature study provided an overview of the current nanotechnological possibilities. With the contributions from four researchers in the areas of regulations, asset management, and chemical and microbial safety, the framework conditions were established for the use of possible new nanotechnological materials in drinking water. With a view to sharing knowledge and to further refining the framework conditions and issues of concern, a workshop was organised with experts from water utilities (Dunea, Evides, PWN), pipe producers (Pipelife, Sabic, Waterlaboratorium Noord, Wavin) and research organisations (Kiwa Technology, KWR, University of Twente).

Results: still no ready-to-use nanomaterial solution anno 2018

Although the field of nanotechnology is developing rapidly, there are currently no ready-to-use solutions for the control of regrowth on drinking water pipes using nanomaterials. This is related to the knowledge gaps described in the literature concerning safety, effectiveness, costs and lifespan of antibacterial surfaces. There are also no regulations pertaining to the contact between drinking water and materials with nanotechnology-modified properties. The most promising option identified, following an inventory of the different working principles of nanomaterials, involves the modification of the surface topography at a nano level using a hybrid approach, so that both kill-on-contact and anti-biofouling properties arise.

Implementation: follow development of nanomaterials, research PE with low regrowth potential

At the moment, active research into nanomaterials is not on the agenda, and it would be better to follow developments passively. Close consideration to the application of nanotechnology will become an option once there is greater clarity about safety, costs and lifespan. At that point, it would be important to have pilots conducted by or with water utilities, to realise the developments required for drinking water practice. For a successful further development of new (nano)materials for drinking water pipes, it is important that there be a close collaboration between research, industry and end-users, in an iterative research and development process.

Beyond nanotechnology, the current state of science promises easier paths toward reducing the regrowth potential of PE pipes for application in the distribution network. PE has a few advantageous properties (pull-out resistant installation, flexibility), but it is only used to a limited degree in the Netherlands because it frequently shows high regrowth-potential measurements. KWR recommends that research be done on the causes of variations found in regrowth potential between the different manufacturers and different batches of PE, so as to improve the PE production process and to reduce the PE-associated regrowth potential.

Report

This research is described in the report *Nanostructuren op leidingwanden tegen nagroei - een verkenning van mogelijkheden en randvoorwaarden* (BTO 2018.094).

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