

Treatment of rainwater in bitumen roofs open to question

Some water boards do not permit the direct discharge of rainwater from bitumen roofs without additional treatment. Doubts about this approach have led to practical research being conducted into the quality of run-off rainwater

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Much remains unknown in the Netherlands about the quality and composition of run-off rainwater. This general unfamiliarity and lack of knowledge about the possible leaching of specific building materials, such as bitumen, have led to various points of view being formed regarding the right approach to rainwater in urban areas. The difference in viewpoint is found in areas such as the fact that there are more decision trees for how to deal with rainwater than there are water boards in the Netherlands. In some decision trees the direct discharging of rainwater from roofs with bituminous coverings is not permitted without additional treatment facilities. Doubts about the correctness of this criterion have given rise to the initiation of a practical study. These doubts were in part a response to recent laboratory research and the suspicion that previous studies during the nineteen-eighties related to roof coverings containing tar that are now prohibited. The current generation of bitumen roof covering materials have no resemblance to the old, tar roof coverings in terms of properties such as



Bituendak in Enschede

PAH (polycyclic aromatic hydrocarbon) content and leaching characteristics. To clarify the actual emissions, a study was carried out in 2008 into the quality of rainwater running off from bitumen roof coverings.

Research questions and approach

Three questions were formulated at the beginning of the study. How do the concentrations in the rainwater running off from bitumen roof coverings stand in relation to the quality standards? How do these concentrations stand in relation to the average quality of running off rainwater in urban areas? Finally, on the basis of the answers to the first two questions, is there any need to treat rainwater originating from bitumen roof coverings differently from rainwater from other roofs? The research was conducted on the basis of a literature study focusing on the various types of bitumen roof coverings and their composition, laboratory research results and practical studies previously carried out. The literature study was followed by practical measurements of the rainwater running off from roof coverings at various locations in the Netherlands.

Bitumen

There is a big difference between the modern bitumen roof coverings and the roof coverings of the past that contained tar. There is an essential difference between products containing coal tar and those made entirely of mineral oil bitumen. Coal tar consists largely of PAH, implying that in roof coverings

containing tar 100,000 milligrams of PAH can easily be present in each kilogram of product. Mineral oil bitumen products, on the other hand, contain no more than 10 milligrams of PAH per kilogram of product. Products containing coal tar have been prohibited since 1989 and their use declined sharply from the beginning of the eighties when roof insulation increased. In the newer residential districts and business premises, the roof covering will not therefore contain any coal tar. This research focuses on the modern (mineral oil) bitumen roof covering.

Leaching

The Dutch Soil Quality Decree sets environmental hygiene standards for building materials and their application. The decree is intended to prevent soil, groundwater and surface water from being polluted by environmentally harmful substances from building materials getting into the environment. For anorganic components (heavy metals and salts) standards are therefore set for the emission (leaching) of these components from the building material. There are not yet any leaching requirements for organic components such as PAH. The Soil Quality Decree does however set requirements for the maximum PAH concentration in the building material. Bitumen roof coverings are among the products covered by this Decree, and are inspected as such and certified (NL-BSB and/or KOMO) to make sure that no products containing tar contaminants are used.

Although there are not yet any statutory leaching requirements for organic pollutants, some usable leaching tests have already been developed. These tests show that the leaching of PAH from bitumen roof coverings cannot be demonstrated. As well as the low concentrations in the roof covering material, PAH is so strongly encapsulated in the bitumen that it cannot escape.

The practical situation can differ on two points from the laboratory test. First, the leaching process can theoretically increase as the roof covering ages. Secondly, the composition of running off rainwa-

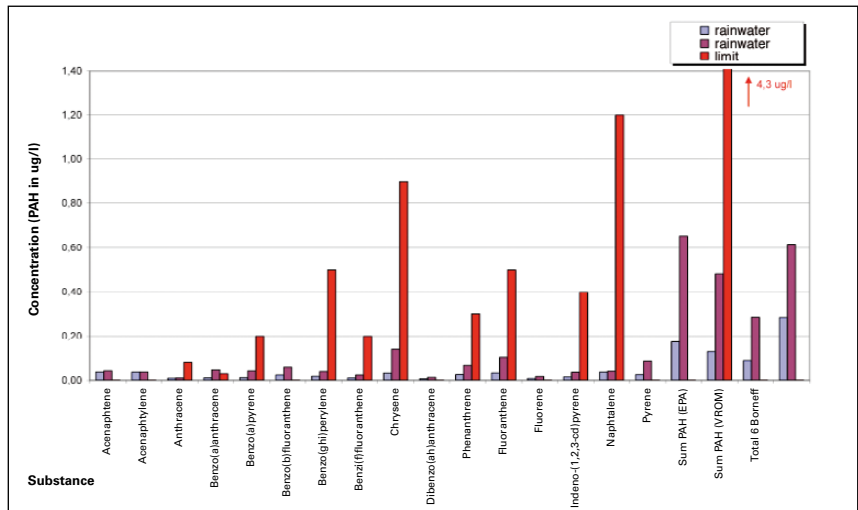
THE RESEARCH IN A NUTSHELL

- Current bitumen roofs have no resemblance to old tar roof coverings
- Practical measurements of rainwater streaming from bitumen roofs at various locations
- PAH concentrations remain under the values for maximum permissible risk
- Quality of rainwater from bitumen roofs similar to other roofs in cities.

ter is in practice more complex than the composition of the demineralised water in the laboratory setup. The water can in practice contain organic substances that influence the result. It is known, for instance, that the solubility of PAH increases when it is bound to humus-like substances. Substances such as these can get into the streaming rainwater as falling leaves, moss, and so on. A practical verification of the quality of the running offrainwater is desirable.

PAH concentrations

In the context of the international study 'Skills Integration and New Technologies (SKINT) for rainwater', more than 7,500 analyses were taken at some two hundred national locations of PAH concentrations in the rainwater streaming from roofs and roads in the urban area and added to the rainwater quality database (Stowa 2007). This has shown that the PAH concentrations in the urban area feature large bandwidths for each location and shower (also within a shower) in the urban area. The extent to which the figures relate to water originating from roofs with a bitumen covering is often unknown. At one location in the Ruwenbos district in Enschede, more than ten analyses are known for rainwater running off from a flat roof with a bitumen covering and a sloped roof with roof tiles. It turned out that the PAH concentration from the bitumen roof was no higher than that from the roof tiles. Since it is improbable that PAH leaches out of roof tiles, it can be concluded that atmospheric deposits form the principal source of PAH from both roofs. It is known that PAH are released from all sorts of combustion processes, such as vehicles (especially older diesel engines) and wood burners.



Source: Tauw

RAINWATER QUALITY

Average quality of the rainwater from bitumen roofs in the practical study. Precipitation = directly collected rainwater; rainwater = precipitation that has streamed over the roof.

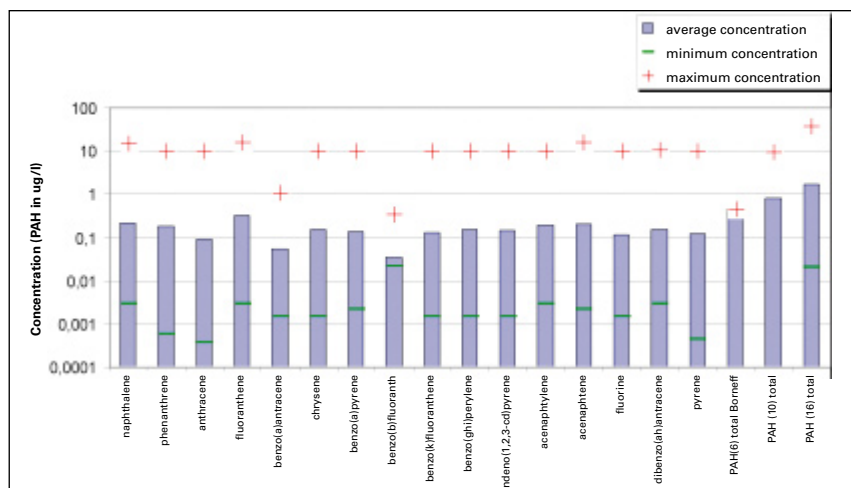
Research results

The quality of running off rainwater can be affected by various factors. They include the age of the roof, the composition of the roofing material, location-specific conditions (pollution, air quality), seasonal conditions (variations in air quality and rainfall/evaporation) and climatic conditions (dry periods, shower intensity). Taking these factors into account, six roofs were selected throughout the Netherlands (Diemen, Bunschoten, Den Boch, Utrecht and Veghel). Measurement apparatus was placed on these roofs to sample the running off rainwater. Three samples were taken from each roof during various showers.

The average PAH concentrations in the rainwater running off from roofs and roads in the urban area (as laid down in the literature study) and the practical measures yield results in values under

the MPR values (MPR = maximum permissible risk). No specific standards for the quality of running off rainwater have been set in the Netherlands. Since rainwater is usually discharged to the surface water when disconnected, the running of rainwater is generally tested against the MPR values for surface water. It also transpires that the concentration of PAH and other substances increases when running off (difference between the quality of rainwater and streaming rainwater). That is caused by the addition of precipitated particles (dry deposit), but a contribution owing to leaching cannot be completely ruled out.

The measured concentrations in rainwater running off from bitumen roof coverings are lower than the MPR values and are also lower than the average concentrations in the rainwater streaming from roofs and roads in the urban area (source: rainwater quality database).



Source: rainwater quality database, 2009

PAH CONCENTRATIONS

PAH concentrations and spread in the rainwater running off from roofs and roads in the urban area.

Same treatment

The information collected during this study justifies the conclusion that the rainwater from roofs with bitumen coverings that do not contain tar does not need to be treated any differently from water from other roofs. Only a limited amount research has been conducted in the Netherlands into the composition of rainwater streaming from roofs. Additional research featuring more variation in factors such as the material type, location, age and season is therefore recommended.

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