GIMAT Liquid Monitoring

Application News
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Of Official Regulations and Individual Solutions – GIMAT Handles Challenging Conditions

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An asphalt mix plant stores large amounts of used asphalt for possible recycling and reuse in road construction on its company site in Germany. The asphalt storage covers a considerable area and is not roofed. Trucks with additional asphalt arrive frequently. The responsible local authorities, worried that the stored asphalt might contain carcinogenic polycyclic aromatic hydrocarbons (PAH), issued a new regulation: the asphalt mix plant should provide evidence that rain did not wash out any hazardous substances into the public sewer system. In order to be able to provide this evidence the asphalt mix plant entrusted GIMAT with the planning of the required measurement equipment. Otherwise a vastly more expensive follow-up regulation, demanding a roof to protect the stored asphalt from rain, was feared.

Economic use of resources is common practice in road mantenance by now: Old asphalt is recycled and can then be reused in road construction. Asphalt used as road surface is a composite material consisting of stone in appropriate grain size and a binder. The binder can be tar or bitumen.

The polycyclic aromatic hydrocarbons (PAH) are a big group of organic substances, among them many carcinogenic or toxic ones. The PAH content of tar is approx. 1000 times higher than that of bitumen. Consequently the use of tar in road construction has been banned in many countries; it is prohibited since 1984 in Germany.

Old road surface however can still yield old asphalt containing tar with high PAH content. German regulations distinguish this reclaimed asphalt by PAH content and set up different rules for reuse. The rules for the storage of tar-containing reclaimed asphalt are strict and designed to prevent the leaching of PAHs caused by rain water.

This was exactly the problem the asphalt mix plant which contacted GIMAT was facing now with the

local authorities' new regulations: Providing evidence that no PAHs were being washed out of the reclaimed asphalt stored on the company site. The authorities thereby expressed their concerns that the local asphalt mix plant might not be handling tar-containing high PAH asphalt with the appropriate care.

The asphalt mix plant was instructed to take retention samples of the water runoff from the company site during rain, in order to allow analysis of the critical parameters PAH and turbidity in a certified laboratory. According to the authorities this should be achieved with an automated sampler with 12 bottles, installed directly in front of the connection to the public sewer system. After checking the authorities' statement is became evident for the asphalt mix plant, that a customised solution would be required.

Challenge: Interpretation of the Regulation

The new regulation issued by the authorities was lacking many details. The condition worded "on rainfall" left plenty of room for interpretation. When and how often should samples be taken to ensure that the renention samples are representative? The asphalt mix plant, realising that they were not able to interpret the official statement without remaining doubts, entrusted GIMAT, manufacturer of vacuum samplers with nearly 45 years of experience in measurement and sampling technology, with professional consulting and the following technical realisation of the project. GIMAT relied on the know-how and experience of subcontractor SERVITEC in matters of auhority-oriented engineering and construction.

Measure Rain or Precipitation?

Only rain is explicitly mentioned by the authorities. However, if you try to assess the motivation behind the regulation it is questionable if a literal interpretation is sufficient or if other forms of precipitation, such as hail or snow, have to be covered as well. These other forms of precipitation yield water as well which might lead to PAHs leaching from the asphalt. Such a wider interpretation was deemed sensible and appropriate in the planning phase.

There was no indication how many samples were to be taken during rain, although the intensity of precipitation can vary greatly, from drizzling rain to heavy rain. As a consequence a decision was made to use a flow proportional sampling in order to obtain representative mixed samples. This made a flow measurement, used to control the sampling, an additional necessity.

The official statement did not contain directions on the measurement methods. A feasibility study on site revealed that rain water needed considerable time to flow through the piles of asphalt. This made an initially considered precipitation sensor useless: A sampler connected with this sensor would try to take samples long before the pipe where it is taking its

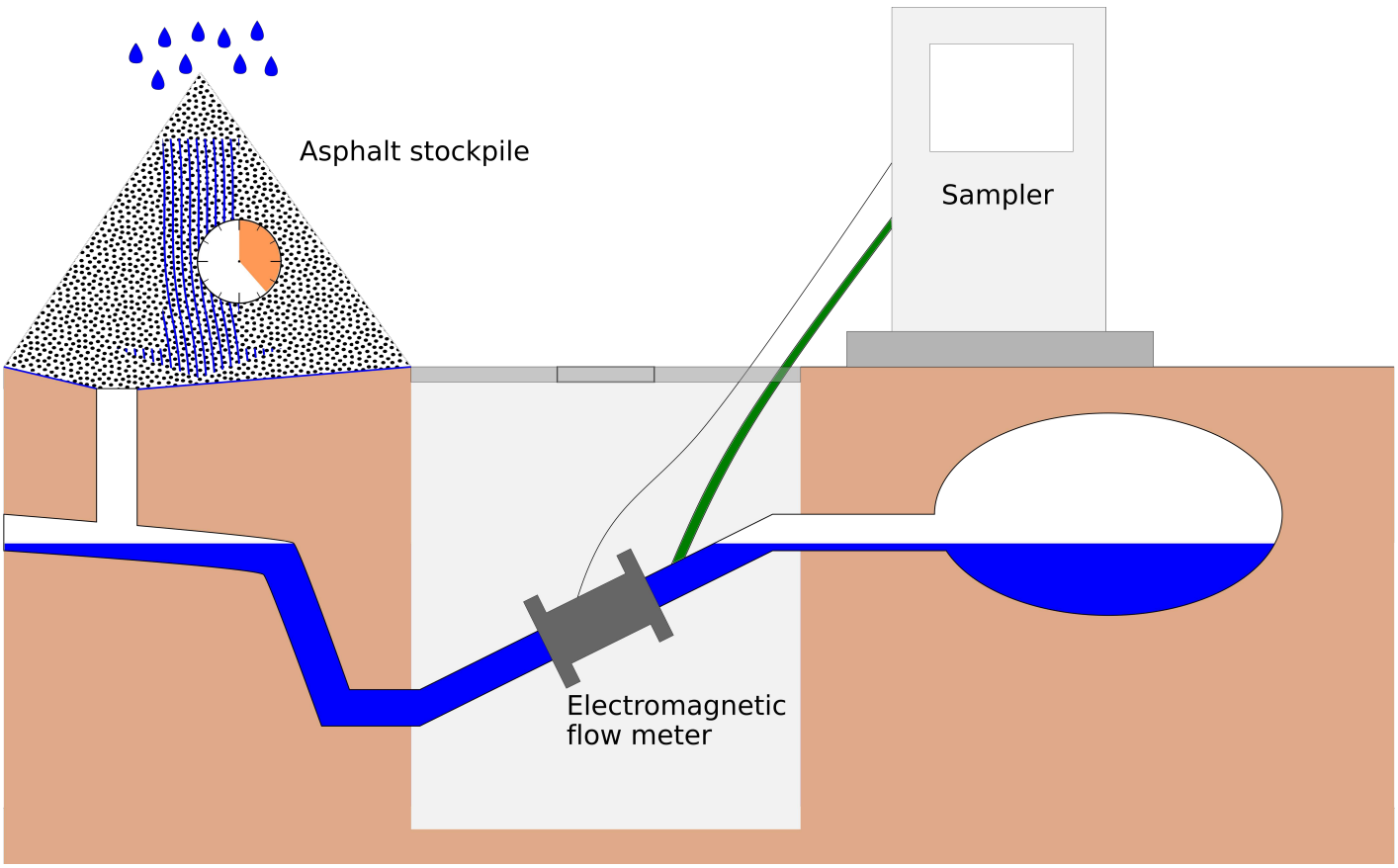

Figure 1: Schematic view of the measuring section with flow meter and sampling point in the shaft

samples from even holds water. In the same way it would quit sampling too early every time the rain stops. The idea of controlling the automatic sampler with a precipitation sensor was therefore no longer pursued.

What is the Appropriate Measurement Method?

GIMAT as supplier of ultrasonic and pressure measuring instruments for flow conducted a price comparison and decided for a magnetic-inductive flow meter. As construction of a culvert was possible the decision fell in favor of a magnetic flow meter for completely filled pipes. With this setup even snow will be detected at the only sensible moment, after melting. The magnetic flow meter will be used to control the sampling. Other possible measurement devices were discarded for several reasons: open flumes require maintenance and inspection more frequently throughout their lifetime. Magnetic flow meters for partially filled pipes are noticeably more expensive on purchase than those for completely filled pipes. The measurement principles ultrasonic and pressure require regular maintenance and inspection. Clamp-on instruments are difficult to set up and their accuracy can diminish with increasing operating time.
GIMAT designed a shaft directly in front of the connection to the public sewer system. Dimensioning of the measuring shaft was done by GIMAT, together with dimensioning of the settling sections on both sides of the magnetic flow meter, of the culvert which ensures complete filling of the pipe and of the intake socket for vacuum sampling (see figure 1 and 2).

How many samples?

The selected magnetic flow meter SITRANS MAG 5100 from Siemens can be set up to output one impuls per cubic metre for the automatic sampler thus enabling a flow proportional sampling. Official directions, how many samples are necessary for each detected event, were missing. For that reason it was made sure that the sampling interval was adjustable, so changes were readily possible at a later time. Bottles with a capacity of more than 2 litres were used, which allowed collection of up to 40 samples per precipitation event and bottle, ensuring representative mixed samples.

Figure 2: Culvert with measuring section for flow meter and sampling point in the shaft

Customer-specific Software

In order to register rain events in a sensible way with the sampler a simple flow proportional sampling was not sufficient. Common sampling controllers do not offer enough customisable parameters cover all conditions of this unique application in a satisfying way. At which intensity of precipitation should sampling start? At drizzling rain, which yields only minuscule amounts of water? Do several rain showers happening on the same day have to be separated?
A threshold value for the flow was introduced. Only flow above this threshold was recognised as significant and triggered sampling. This threshold value could be customised afterwards as well.
To allow separation of events an interval for event separation was implemented: If the flow is below the threshold for a certain amount of time (adjustable by user, e. g. several hours) the sampler declares an end for this rain shower and switches to a new bottle. This sensible action allows to analyse the rain showers separately. The analysis results can be related to certain dates and times.

Status Messages

In contrast to classical flow proportional sampling in this case, where the sampling rate depends completely on precipitation, it is impossible to predict when all the bottles of the sampler will be filled. When that happens the bottles have to be taken out and sent to the laboratory by the operating personnel before the sampler can be restarted. The asphalt mix plant requested an easily accessible view of the sampler's progress. The software of the sampler was modified accordingly. The number of the active bottle is now visible as message and graphically illustrated (figure 3). This saves the staff a regular personal inspection of the status of the sampler. It also prevents the sampler from getting stuck in standby, which would happen as soon as all bottles are full if the staff forgets to exchange them.

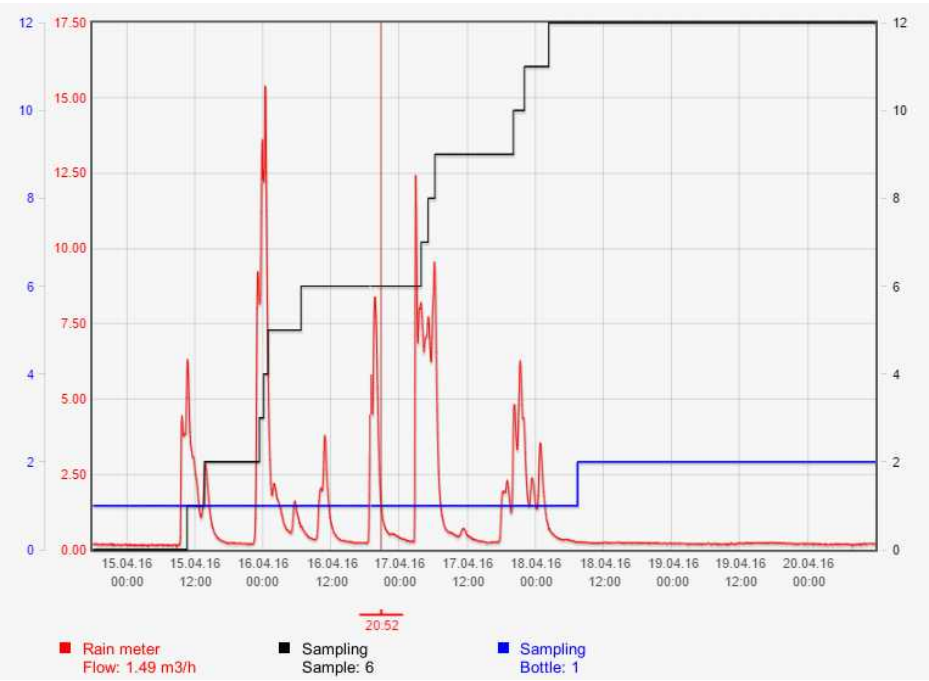

Figure 3: Visual representation of the flow with sampling times and the number of the rain events.

Figure 4: Measuring station, complete with sampler, measuring transducer of the flow meter and remote data transmitter

Remote Data Transmission

There were no ducts for data or signal transmission on the company site. GIMAT suggested remote data transmission using its Easy2Com system to make the data accessible online. This solution allows access to current and older data through a customer-specific website including the download in Excel-compatible format for further evaluation and documentation.
One of the advantages of the system is the plug & play feature, which renders hardware modifications unnecessary. The connection is secured and the website password-protected.

Results

The concept developed by GIMAT was discussed with the authorities and approved before implementation.
The measuring station (figure 4) was built with sampler, measuring transducer MAG5000 for the flow meter and remote data transmission.
After that all instruments were delivered to the customer including installation, commissioning and training of the operating personnel on site. GIMAT later provided further assistance in fine-tuning the operating parameters.
A certified laboratory has been doing the PAH analyses of the collected samples since the installation.
A measuring task, seemingly simply on first look, but surprisingly complex in terms of realisation could thus be fulfilled with full approval of all affected parties.