PAVEMENTS OF CONCRETE ELEMENTS, IMPERMEABLE FOR LUBRICANTS AND FUEL

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SUMMARY

In The Netherlands the Government is confronted with the need to establish directives for the certification of pavements of concrete elements that are leakproof to lubricants and fuel. This question was directly dictated by pollution of the subsoil due to spillage that had been observed by many petrolstations in the country.
A special committee consisting of 20 experts of the parties concerned was installed. It was decided, that the type of construction would be a pavement of concrete elements, impervious to lubricants and fuel and with a special sealing in the joints between these elements. Three directives were worked out:

a directive on specifications tor the sealants
a directive on specifications for the concrete elements
a directive containing measures to be taken into account while constructing the pavement.

Concrete was chosen for the small tolerances that can be obtained by the manufacturing of concrete elements.
Monolite constructions were considered not to be suitable because of the required accessibility of the infrastructure under the pavement. Within the lifespan of the pavement many changes in the pattern and function of the pipes, cables and tubes will occur. Also repairactivities are easy to be carried out.
The use of impermeable interlayers was rejected while they are unreliable on the long term.
To give an indication of the resistance of an element against penetrating liquids a special test was established. In each directive special attention was given to a qualitysystem and how to assure the quality of the specific product. The directives are in service from may 1991.

1. INTRODUCTION

Why leakproof pavements for petrolstations ?
Fuel for cars can be a threat for the environment. This is a rather old problem, cause since people started to use automobiles one century ago, fuel entered the scene. In 1927 in The Netherlands a "Petrol Committee" was established to draw up regulations for storing petrol. By then safety was the main item, not environment.
After these regulations were presented the committee still stayed active and changed its name in "Committee for Prevention of Disasters". More regulations were presented for transport, transshipments, storages and processing of matters that in case of an accident can be a threat for man and environment. The members of this committee were chosen from all the parties that were involved, like people from the administration, the oil companies, the licensees and independent experts. Requirements were laid down for underground storing and equipment for filling stations.
Yet there was more to be settled and the attention was drawn to the petrolstations. A new ad-hoc-committee made an atrandom investigation on fifteen stations that were located in areas for the winning of drinking-water. These areas were considered to be the most vulnerable to pollution caused by fuel or lubricants. The results were alarming. A number of recommendations were made and the authorities decided to take measures. In 1989 a program was developed for all the public petrolstations in the country

(± 7200). Another committee of experts was installed to set up criteria for certification and in eight years all the stations have to be adjusted to these rules.

2. THE TECHNICAL SOLUTION

Prevention of pollution of the subsoil and ground water can be obtained by different systems. The spillage can be catched on the surface of a pavement or, after it penetrated the top layer, under the surface. Catching the spillage under the surface can be done by using an impermeable membrane and leading it away to a controlled reservoir. The committee rejected this solutions because of the fact that the membrane is hidden in the ground. Damage by for instance roots or unevennesses can not be spotted in time and if a reconstruction, rearrangement or repair of the cables, tubes, pipes and reservoirs that are positioned under the pavement of the station takes place, the membrane can easily be disturbed. Besides that, the zone above the membrane will be polluted very badly.

It is better to catch the spillage on the surface before penetration and lead it away by an effective drainage system in a controlled reservoir where it can be collected for processing. This solution implies an impermeable, leakproof pavement that will be impassive to petrol, oil or diesel. So, bituminous solutions with asphalt are not suitable. The most economic pavement will be a cementbound surface. The most effective construction would be a monolitic layer of concrete. This solution was not chosen because it has become clear by experience that very frequently the tubes, cables and reservoirs under the pavement are changed. Breaking up a monolitic layer is more expensive than taking out elements that can be manipulated by hand and/or light tools.

The committee that was established to set up the criteria for certification has chosen for a leakproof pavement of concrete elements with sealed joints.

Elements means that the dimensions can vary from 110 x 220 mm to 2 x 2 meter. The biggest dimensions are limited by the fact that the element must be tractable by light tools.

Concrete is chosen because of the fact that precast concrete products can be manufactured with low tolerances and at a profitable price.

Every product has its own advantages and disadvantages. The bigger elements are very suitable for large surfaces like places for transshipments and manufacturing halls. Laying can be done in a relatively short time and rather little joint sealant is needed. Application however must be done very carefully to make them fit very tight. Complicated patterns and the junctions with pump islands ask for a lot of adaptations. Special application tools are needed and small repairs are not easy to be carried out. Due to the relatively large movements of the edges of the flags the joint sealant will be charged quite heavy with all the risks for the impermeability.

Small concrete elements have the advantage of the greater flexibility in junctions and patterns and in most cases they can easy be layed by hand. A disadvantage is that laying is labourintensive and because of the large amount of joints much sealant is needed.

It was decided in the committee to draft 3 directives with criteria, namely for the concrete elements, the sealants and the way of applying the pavements. These 3 directives are coherent and must be used in combination, they don’t stand on their own.

3. PRESCRIPTION OF THE CRITERIA FOR CERTIFICATION

The committee that had to draft the directives with criteria was made up of representatives of the oilcompanies, the contractors, the manufacturers, the principals, the independent experts and the certifying institute.

The criteria for the sealants did already exist and they were adopted by the committee.

3.1. Concrete elements

The first requirement for concrete elements used for pavements in petrolstations is that they are impermeable for motorfuel and lubricants. This means both that the surface of the block or flag has to be impermeable and that the joint has to be impermeable.

To test the resistance against penetration of fuel and lubricants, a special test was specified in the directive. In this test that is carried out after 28 days, dieseloil is put on the upper surface of a cylindrical testspecimen with a minimum diameter of 100 mm and that has been taken from an element. The penetration of the dieseloil in the concrete may not exceed 50 mm. the test is carried out conform article 6 of the ISO/DIS 7031. If a toplayer is used for the upperface of an element this layer must have a minimum thickness of 4 mm. It is no need to say that the toplayers must be properly attached on the rest of the element.

Also the shape of the notch of the joint has to be defined. A distinction is made between small elements and bigger elements. A small element has nominal dimensions that don't exceed a square of 750 x 750 mm. Bigger elements exceed this square of 750 x 750 mm but stay within a square of 2001 x 2001 mm. In figure 1 is indicated which dimensions for the notch can be used. The exact dimensions have to be established in consultation with the suppliers of the joint sealant and the manufacturers of the elements.

small elements $8 \leq b \leq 20$

big elements $12 \leq b \leq 20$

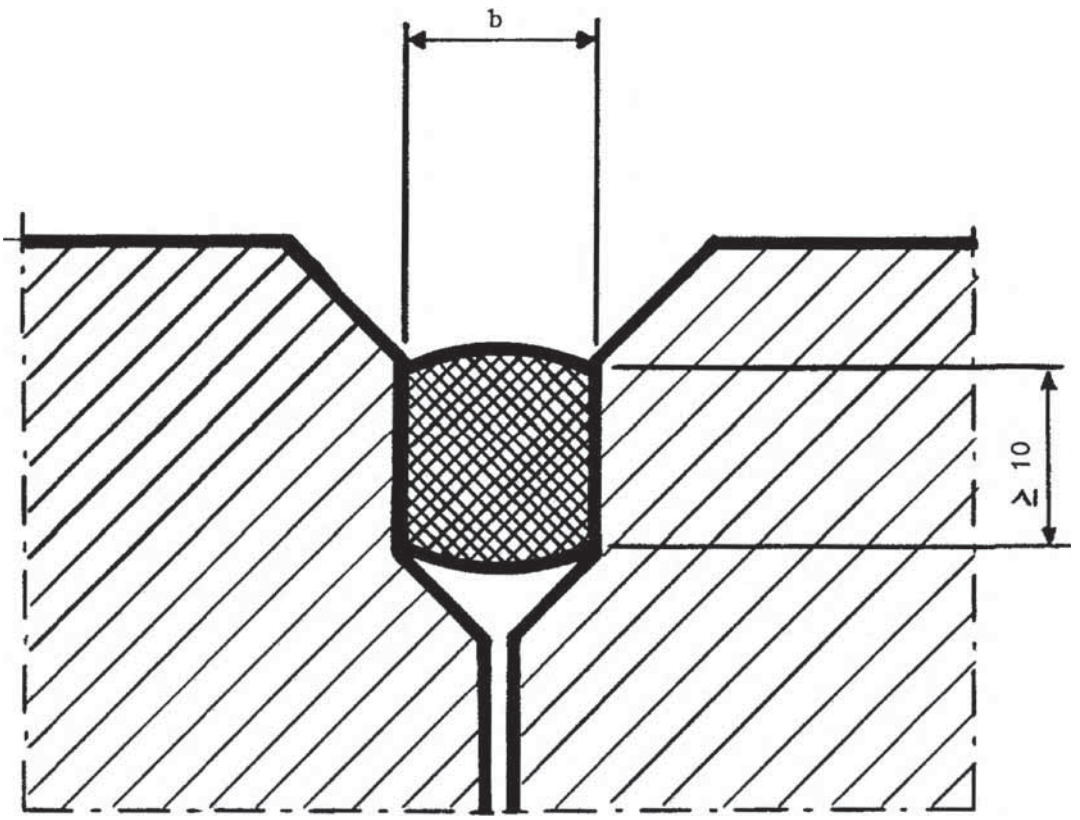


Figure 1: Sketch of a joint with sealant

The directive contains a lol more criteria like shape, appearance, strength, evenness, chamfer, dimensions, tolerances and sandblasting. These properties are defined conform the criteria for elements for normal use.

A special chapter is dealing with quality control in the factory. The manufacturer has to use a quality system. This system must have the following elements:

- an acceptance control of the raw materials
- a control during production
- a final control of the product
- a control of the testing equipment
- a control of the internal transport and storage.

In a special schedule the controlactivities are defined. Furthermore there is a list of the producers testequipment that is required as a minimum.

Finally a procedure is given for complaints about the products delivered. This procedure must have the following elements:

- a procedure in print to discuss complaints
- a functionary responsible for handling complaints
- a registration of the complaints
- a feedback to the production division or division for quality control
- a registration of the measures taken.

3.2 Application of pavement

Besides all kind of common information like definitions, explanation of abbreviations, responsibilities etc., this directive aims at the requirements for the process of applying the pavement.

It starts with requirements for the drawings, the calculations and the responsibilities of the contractor and the premises that are given. For instance a soil mechanical survey is needed, the lifecycle has to be established, a verification in print of the design must be available, there must be a procedure for handling the drawings. The place where the petrolstation has to be built must be surveyed by the contractor and the purchaser after an inspection of the building place by the contractor.

A lot of articles are placed in this requirement, that are very common for the daily practice of applying pavements of elements.

Very special is that the personnel that is deployed by the contractor has to be qualified for the special jobs. Especially the filling of the joints has to be done by skilled people.

Besides the results of a final control, a recommendation for the maintenance in print has to be given by the contractor.

In conclusion a description is given of the requirements for the quality system that has to be used by the contractor.

4. REMAINING WISHES

The committee is convinced that the three directives will make it possible to hand out certificates for the products described and their applications. There are still wishes left to complete these criteria.

At first the method of design has to be given for the particular circumstances and loadings. All kinds of details can be described.

A suitable drainage system for collecting the spillage must be described. Other special devices that serve the safety and prevent pollution have to be prescripted.

Maintenance and repair will need another study and drafting of directives on this subject is necessary.