

PENETRATION OF LIQUIDS INTO POLYMER CEMENT CONCRETE

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SUMMARY

Tightness of the construction is an important factor concerning concrete used for gasoline stations or for catching-basins in chemical plants. Polymer cement concrete shows an impressive reduction of the penetration depth dependent on the quantity of polymers added. In the following text the results of extensive tests with [®]Mowilith LDM 6880¹⁾ (copolymers consisting of styrene and an ester of acrylic acid) and different organic liquids as penetrating liquid are shown.

1. INTRODUCTION

Following numerous tests on the penetration depths of concrete at the Technical University of Darmstadt in the last years, we started to test polymer cement concrete.

2. TEST SERIES

With the aim of getting extensive knowledge about the penetration behavior of organic liquids in polymer cement concrete we started several test series by varying the amount of polymers and by using different liquids. According to possible applications the liquids tested

¹⁾ product of Hoechst AG

were mainly gasoline and Diesel oil. In addition some less common organic liquids were tested for special projects in the chemical industry.

In order of existing standards two different testing methods were used (see [1] and [2]). Most of the analysed concrete samples were tested in a 72 hours modus with a liquid level of 1,40 m. To verify the results some intermittent applications were realized. In addition the influence of time concerning the penetration behaviour was tested in long-time applications.

In the following diagrams the results of this tests are shown. In Fig.1 one can see the effect of increasing the polymer content in a 72h application with gasoline.

- Concrete mixtures:
- w/c-ratio = 0,45
 - aggregate AB 16
 - 30 kg/m³ coal fly-ash
 - 0-60 kg/m³ Mowilith

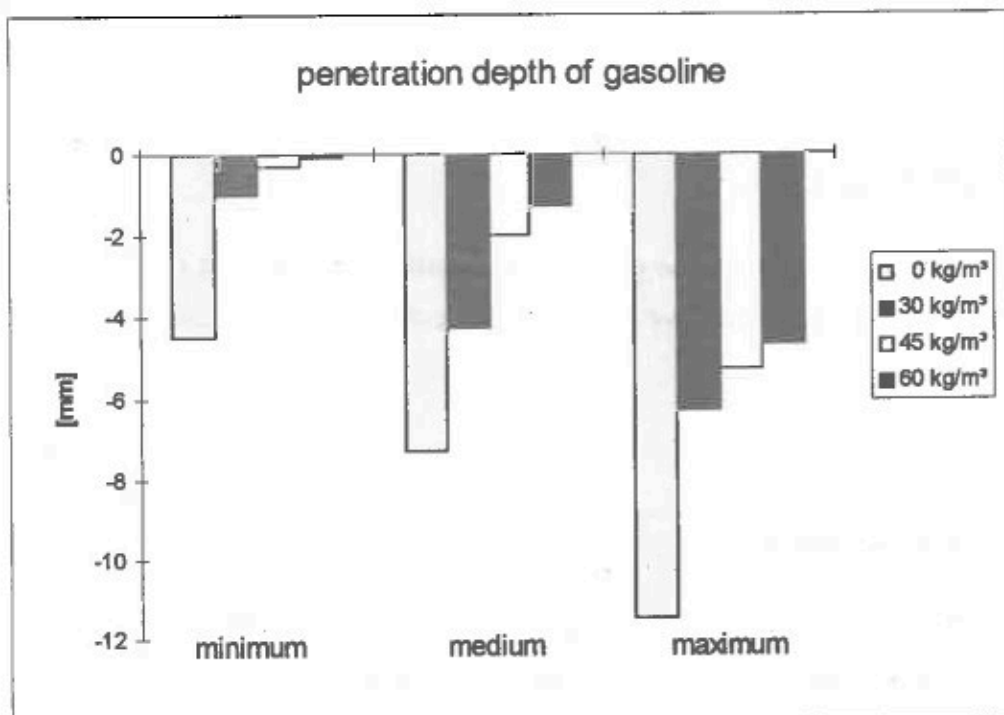


Fig.1: penetration depth dependent on the polymer content

Tests with Diesel oil have shown a similar behaviour. The depths are according to the material properties bigger.

Test with N-Methylpyrrolidone showed no significant effect after 72 hours (Fig.2).

Concrete mixture:

PCC: w/c-ratio=0,48, AB 16, 30 kg/m³ coal fly-ash, 30 kg/m³ Mowilith

CC : w/c-ratio=0,48, AB 16, 70 kg/m³ coal fly-ash

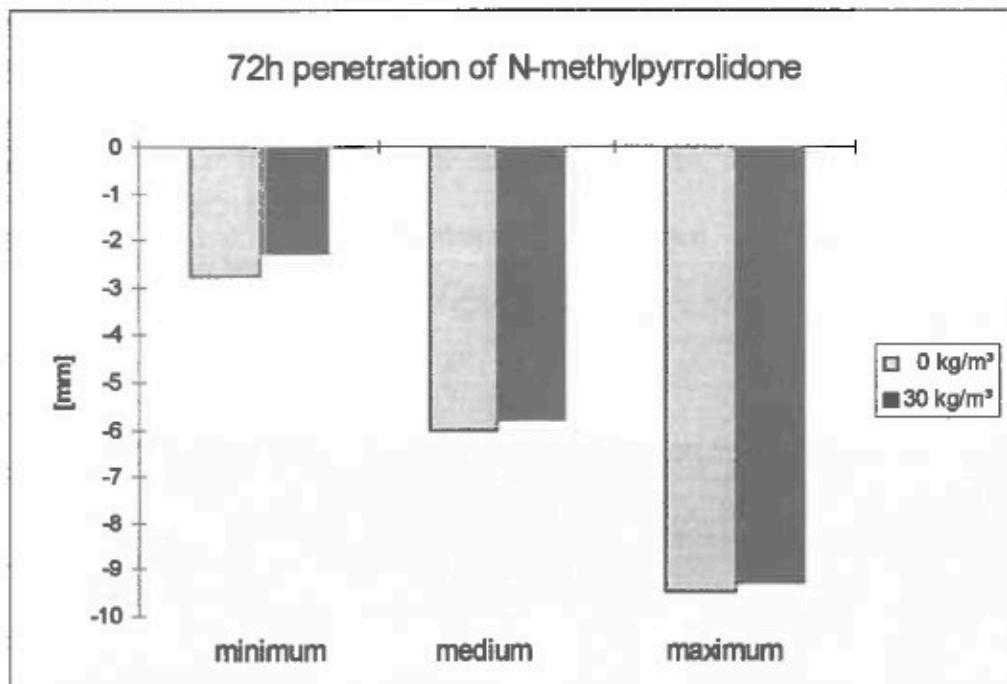


Fig.2: 72h application with N-methylpyrrolidone

In non-standard tests the qualities of polymer cement concrete are seen even more evidently. The following Fig.3 shows the results of a 36d application with N-methylpyrrolidone as test medium.

The results showed in Fig.3 are documented in Fig.4. The photo was taken immediately after splitting of the concrete samples.

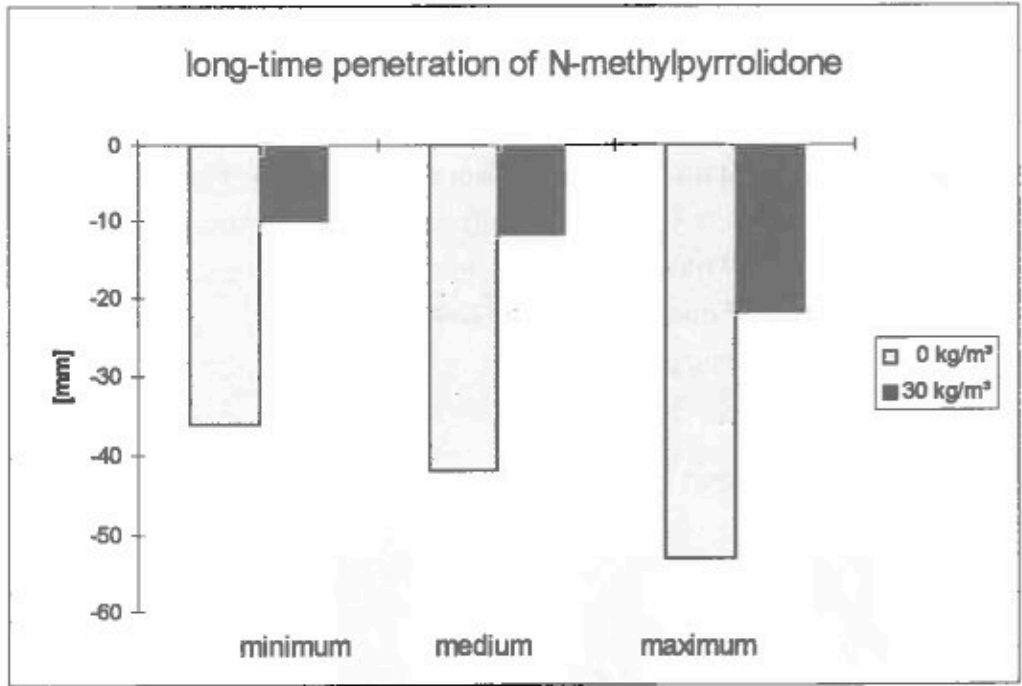


Fig. 3: 864h application with N-methylpyrrolidone

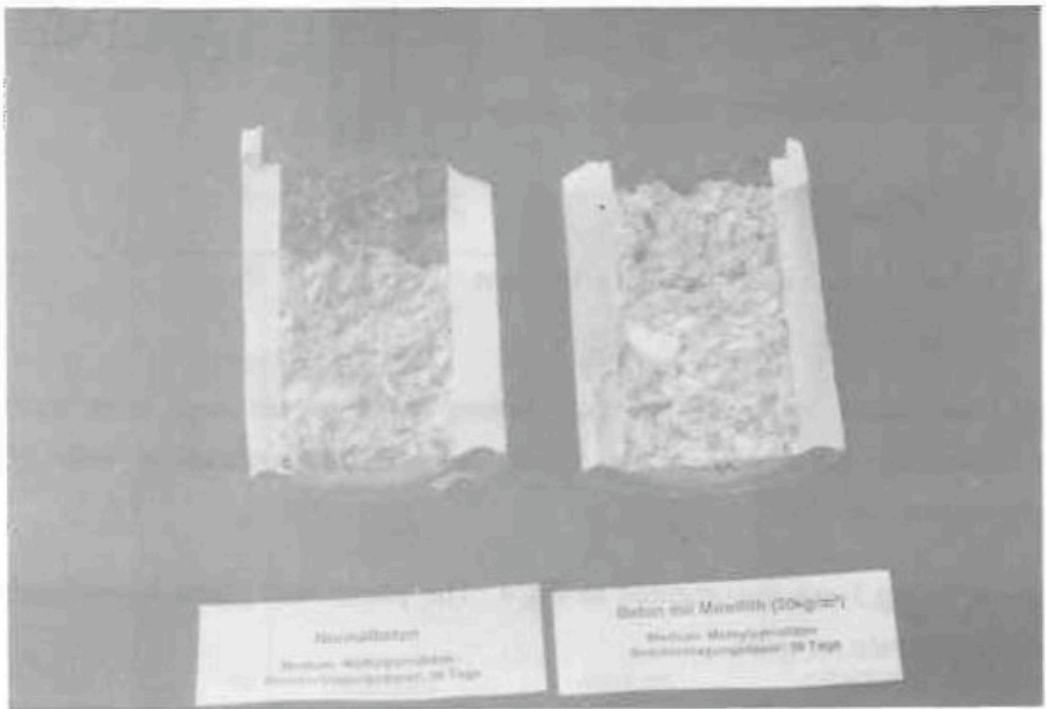


Fig. 4: samples of the 864h application

In comparison with the 72h results the influence of the polymers on the penetration stick out (Fig. 5).

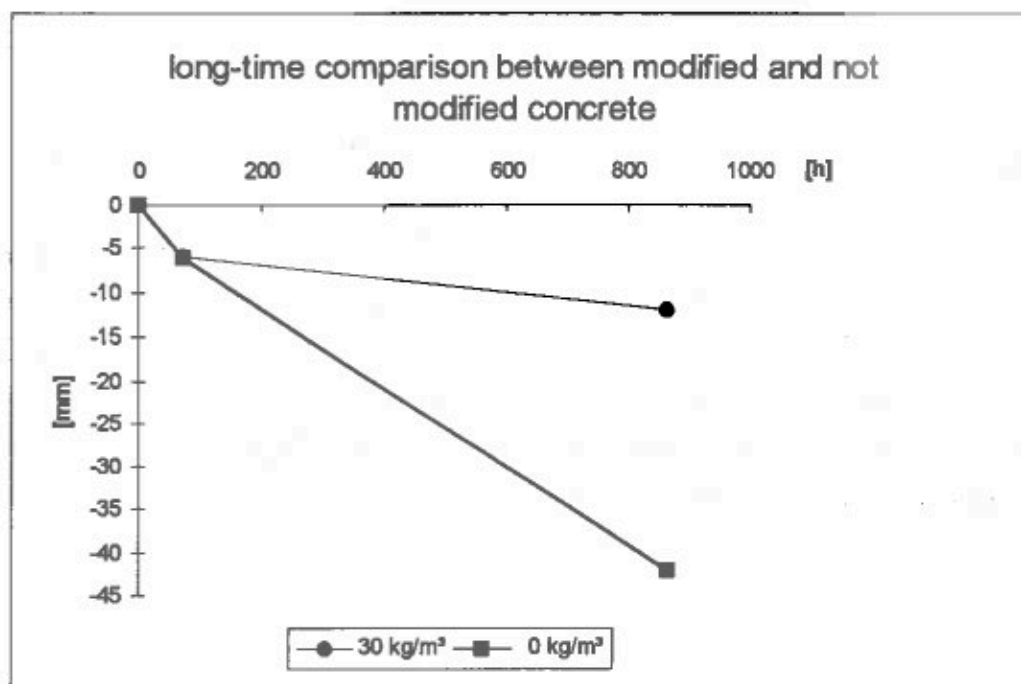


Fig. 5: Long-time comparison between modified (30 kg/m^3 Mowilith) and concrete with modification

In future standards [3] a 144h application will be demanded. This will influence the penetration depths for the benefit of polymer cement concrete.

There are two possible explanations for the effect of the reduced depth of penetration:

- the size of the polymer parts

As a result of their size (0,1-0,3 μm) the polymer parts fit exactly in existing cavities.

- the polymers swell by contacting liquids

Getting in contact with organic liquids the polymers enlarge their volume. This effect is a function by the time and the used liquid.

3. CONCLUSION

The depth of penetration of organic liquids can be influenced efficiently by adding polymers to the concrete. Polymer cement concrete shows qualities which enable it to form an effective barrier against organic liquids.

References

- [1] Deutscher Ausschuß für Stahlbeton: „Richtlinie für Betonbau beim Umgang mit wassergefährdenden Stoffen“, 1992, Beuth-Verlag
- [2] Hessisches Ministerium für Umwelt, Energie und Bundesangelegenheiten, Tankstellenverordnung, AGS 1-16, April 1994
- [3] Deutscher Ausschuß für Stahlbeton: „Richtlinie für Betonbau beim Umgang mit wassergefährdenden Stoffen“, Entwurf '95