

Summary

Investigation concerning the long-term behaviour of Polygum roofs in practice

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1 Order

ATAB NV / SA in Antwerp has ordered an investigation into the long-term behaviour of Polygum APP-roofs¹⁾ in practice.

Starting points

1. From a reference list established by ATAB, including 30 projects, BDA has selected seventeen projects: six in Belgium, four in Sweden, five in the Netherlands, and two in Northern France.
2. Incisions have been made on these projects. The samples of these incisions have been investigated in further detail for:
 - thickness (top layers) and cracking
 - dispersion: distribution of polymers in bitumen
3. In five projects, samples have been “aged” in the BDA Ponding Tester (2,000 hours). This is an accelerated ageing method according to prEN 1297-1. Following this, the quality of the dispersion bitumen-polymers after ageing was established.

¹⁾ 15 Polygum roofs with a polyester reinforcement have been examined. From 1995 onwards, Polygum has been delivered with a polyester glass fibre composite. Two roofs of this kind have been examined.

2 Examined roofs

An overview of the examined roofs with building year, adhesion technique and type of adhesion is given in Table 1.

Table 1 - Overview of examined roofs

Object No.	Object	Building year	Adhesion technique	Type
1	Owens Corning in Visé (B)	1984	F	1
2	Janssens Pharma in Beerse (B)	1982	P	1
3	CMC in Wijnegem (B)	1981	F	1
4	Emgo in Lommel (B)	1980	F	1
5	Opel Belgium in Antwerp (B)	1982	P	1
6	Hall des Foires in Liège (B)	1986	N	1
7	Auchan de Roncq in Roncq (F)	1983	P	1
8	Auchan Logistique Nord in Lesquin (F)	1988	F	1
9	Morres Meubel in Hulst (NL)	1978	F	1
10	Conservensteriliseerhal in Giessen (NL)	1984	F	1
11	Supermarket in Den Dongen (NL)	1983	F	1
12	Shopping Centre in Rijswijk (NL)	1995	F	2
13	Flower Store in Bleiswijk (NL)	1995	N	2
14	Bergundaskolan in Växjo (SW)	1986	F	1
15	Covered parking area in Växjo (SW)	1986	N	1
16	Skolfasilgheten Teknikum in Växjo (SW)	1986	F	1
17	Garage Byggnad in Växjo (SW)	1986	N	1

Codes for the adhesion techniques:

N = Mechanical fixing
F = Fully bonded
P = Partially bonded

Type 1: Polygum
Type 2: Polygum polyester glass fibre composite
(polyester glass combination)

3 General impression

The general impression of the examined Polygum roofs is good. It should be noted that the roofing membranes are still in good condition in most cases, and that, subject to yearly inspections and periodic cleaning, no extensive maintenance is required for the time being. Apart from one single exception, there was no question of there being any (future) danger of reduced water-tightness. In the inspection reports concerned, which are included in Appendix 1, a number of recommendations have been made about some aspects to be improved in the area of maintenance.

In fourteen projects, the top layer was finished with slate granules, whereby, with the exception of one membrane, the adhesion of the slate granules was outstanding. In general, the work carried out on the examined roofs appeared to be accurate and professional.

The most common remarks relate to:

- The pollution in the gutter areas due to overdue maintenance
- Shifting (shrinkage) of the transversal overlaps
- Slight local cracking of the upper coating layer of some membranes (see Table 4), as well as cracking in the bitumen that has flowed from the joints.

Figure 1 - Project 5: Opel Belgium (GM) in Antwerp (B) (1982)



Figure 2 - Project 7: Auchan de Roncq in Roncq (F) (1983)



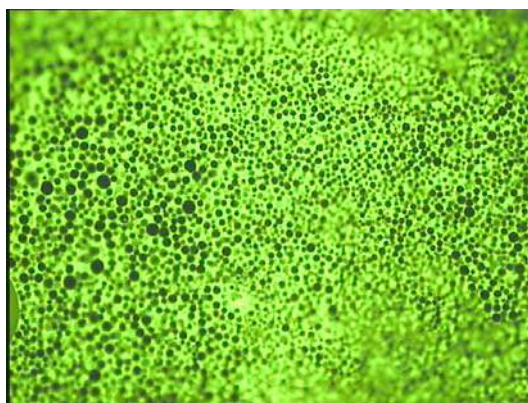
4 Laboratory examination

The BDA Keuringsinstituut BV (BDA Inspection Institution) examined the samples taken from the projects being investigated. For each sample, an examination of the dispersion was made with the help of fluorescent microscopy.

Table 2 gives an overview of the results after fluorescent microscopic examination of the dispersion.

Table 2 - Results of the fluorescent microscopic examination

Object No.	Age (in years)	Quality of the dispersion
1	18	Reasonable
2	20	Reasonable
3	21	Good
4	22	Good
5	20	Reasonable
6	16	Good
7	19	Good
8	14	Moderate
9	24	Reasonable
10	18	Reasonable
11	19	Good
12	7	Reasonable
13	7	Reasonable
14	16	Good
15	16	Good
16	16	Moderate
17	16	Good



Example of good quality of dispersion.

Table 3 gives the results of the fluorescent microscopic examination after the samples concerned had been artificially aged in the BDA Ponding Tester® (2,000 hours).



Table 3 - Results of the fluorescent microscopic examination after artificial ageing

Object no.	Age (in years)	Quality of the dispersion
2	20	Moderate/reasonable
3	21	Good
4	22	Good
9	24	Reasonable
11	19	Good

Finally, the thickness of the upper and lower coating and of the reinforcement were also measured, and where present, the depth and width of cracking, also by means of fluorescent microscopy. The results of this can be found in Table 4.

Table 4 - Results of thickness and cracking measurements

Sample No.	Thickness (mm)			Cracking	
	Upper layer	Reinforcement	Lower layer	Depth (mm)	Width (mm)
1	0.7	0.7	2.5	0.7	0.3
2	0.9	1.1	1.7		
3	0.5	1.0	1.4		
4	1.1	0.7	2.0	0.9	0.2
5	1.1	0.9	1.9		
6	1.0	0.9	1.5		
7	1.0	0.7	1.6	1.0	0.2
8	1.0	0.7	1.8		
9	0.6	0.8	1.5	0.6	0.3
10	1.0	0.8	1.4		
11	0.9	0.8	1.9	0.8	0.2
12	1.0	0.6	1.8		
13	1.0	0.7	1.7		
14	0.8	0.7	1.6		
16	1.3	0.8	1.7		
17	0.8	0.8	1.6	0.8	0.2

5 Proven service life and estimated remaining service life

There is no standardised method for assessing the remaining service life of roofs with APP modified bitumen coating. Five of the examined Polygum roofs have a proven service life of 20 years or more. The examined roofs are on average 17 years of age, whereby the youngest roof is 7 years old. After a real life exposure of 24 years, the oldest roof is still functional in such a way that, based on the inspection examination, extensive maintenance is not necessary in the immediate future (≥ 5 years).

The laboratory examination was geared towards finding possible trends in characteristics that could be related to the age of the roof. Table 5 shows an overview of the results. After studying the table, it was found that, as far as characteristics, quality of the dispersion and crackle are concerned, there are hardly any trends that can be related to age. It is true that the oldest roof shows cracking, but the next-oldest roof (22 years) does not. This is also the case for the three roofs that are 20 years old. A similar result was found for the quality of the dispersion. The artificial ageing only had some effect on one sample (Object 2), where the quality fell from “reasonable” to “moderate/reasonable”.

There appears to be a clear relation between the finishing of the membrane and the formation of cracking. Both objects for which the reinforcement consisted of a polyester glass fibre composite do not show crackle. Age can obviously also play a role here (7 years). On the other hand, it is known in practice that this phenomenon often appears already after a few years if the roofing is sensitive to cracking.

From the 15 objects with a polyester reinforcement, 14 samples have a mineral finish. Of these 14 samples, five roofs show cracking in parts without slate granules. The samples with talc/sand finishing show one case of cracking. It therefore appears justified to conclude that mineral finishing has a positive effect on the resistance to crackle cracking.

A conservative estimate of the remaining service life can be made on the basis of the average age (17 years), the age of the oldest roofs (20, 21, 22 and 24 years) and the established effect of the artificial ageing. The ageing has taken place in accordance with prEN 1297-1 (1994-01) over a testing period of 2,000 h. There is no general definite correlation between the duration of the artificial ageing in the BDA Ponding Tester® and the remaining service life that is to be expected. This means that these results should be considered with due caution. In the meantime, however, BDA has gained a lot of experience in this kind of examination. The main conclusion from the above is that the older the examined sample, the more reliable the statements. On the basis of BDA's experience, it can be considered that an artificial ageing of 2,000 hours is consistent with an exposure of 5 to 10 years in reality. On the basis of the

above, it can be concluded that, in general, the service life of the examined roofs can be set at a minimum of 25 to 30 years, depending to a certain extent on the presence of a mineral finish. Periodic maintenance (cleaning) also will have a positive effect on the actual service life.

Table 5 - Summary of results

Object No.	Age (years)	Type ¹⁾	Finishing ²⁾	Dispersion quality ³⁾		Cracking	Substrate ⁴⁾
				Not aged	Aged		
1	18	P	Min.	2		*	MWR (G)
2	20	P	Min.	2	2/3		PUR
3	21	P	Min.	1	1	*	MWR
4	22	P	Min.	1	1		Cork
5	20	P	Min.	2			EPB
6	16	P	Min.	1		*	PUR
7	19	P	Min.	1		*	MWR (G)
8	14	P	Min.	3			Cellular concrete
9	24	P	Min.	2	2	*	Chipboard
10	18	PC	Min.	2			CG
11	19	PC	t/s	1	1		MWR
12	7	P	t/s	2		*	MWR
13	7	P	t/s	2			MWR
14	16	P	Min.	1			Wood
15	16	P	Min.	-			Wood
16	16	P	Min.	3			Concrete
17	16	P	Min.	1			Wood

Explanation:

1) Reinforcement type: P = polyester
PC = polyester glass fibre composite

2) Finishing: t/s = talc/sand
Min. = mineralised

Value scale

3) 1 = good 2= reasonable 3 = moderate

4) Insulation type: MWR = mineral wool
MWR(G) = mineral wool with glasfibres
EPB = Expandable perlite board
CG = Cellular glas
PUR = Polyurethane board

6 Conclusions and recommendations

- 6.1 The general impression of the examined Polygum roofs is good. This means that no extensive maintenance is required for any of the roofs in the short term.
- 6.2 With one exception, the observed imperfections do not directly or will not in the immediate future endanger the water-tightness, and can be summarised as follows:
- Cracking on the surface of the top layers, depending on whether there is a mineral finishing or not. Resistance against cracking is better when a mineralised finish is available;
 - Insufficient slope and pollution of the roof due to overdue maintenance;
 - At some of the projects, some shrinkage of the membranes at the transversal overlaps is present. The polyester/glass fibre composite reinforcements are dimensionally stable.
- 6.3 Based on the average age of the examined roofs (17 years) and the age of the oldest roofs (20, 21, 22 and 24 years), as well as a conservative assessment of the effect of artificial ageing, the expected service life of Polygum roofing membranes, carried out with good craftsmanship according to the regulations and checked by the manufacturer, amounts to minimum 25 to 30 years, as long as periodical maintenance takes place.


Gorinchem, 02.11.19

BDA Dakadvies BV



BDA Dakadvies B.V.

Prof. Ing. N.A. Hendriks



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A.F. van den Hout



A handwritten signature in black ink on a light yellow background, featuring a stylized initial 'A' followed by a horizontal line.