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REPORT NO. 7

RESULTS FROM EVALUATION OF DECAY OF PAINTED SYSTEMS FOR WOOD, STEEL AND GALVANIZED STEEL AFTER 1 AND 2 YEARS EXPOSURE

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SUMMARY

The results of the 1 and 2 years of exposure of the painted systems for steel and wood is presented for all test sites in the exposure programme.

A general description of the results is presented together with a statistical evaluation. The observed damages were mainly related to the parameters general appearance, dirt, chalking and fungus, for the steel samples also for damages in and around an artificial cut. The damages were generally small and dose-response relationships were difficult to establish after such a short time as 2 years. Slight indications for increasing degradation with increasing load were observed for the parameters SO_2, NO_2, precipitation and time of wetness. For chalking the amount of sunshine increased the damage.

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1 INTRODUCTION

Airborne acidifying pollutants are known to be one major cause of corrosion of different materials including the extensive damage that has been observed on historic and cultural monuments. In order to fill some important gaps of knowledge in this field the executive Body for the Convention on Long-range Transboundary Air Pollution decided to launch an international co-operative programme within the United Nations Economic Commission for Europe (UN ECE). The programme started in September 1987 and involves exposure at 39 test sites in 11 European countries and in the United States and Canada.

The aim of the programme is to perform a quantitative evaluation of the effect of sulphur pollutants in combination with NO_x and other pollutants as well as climatic parameters on the atmospheric corrosion of important materials. For this purpose measurements of gaseous pollutants, precipitation and climate parameters have been initiated at or nearby each test site, together with evaluation of corrosion of the exposed test materials at each site.

A Task Force is organizing the programme with Sweden as lead country and the Swedish Corrosion Institute serving as the Main Research Centre. Sub-centres in different countries have been appointed, each responsible for their own materials group. The materials groups are:

Structural metals, including steel, weathering steel, zinc and aluminium (Sub-centre responsible for evaluation: National Research Institute for Protection of Materials, Prague, Czechoslovakia), copper and cast bronze (Bayerisches Landesamt für Denkmalpflege, Munich, Germany).

Stone materials, including Portland limestone and White Mansfield dolomitic sandstone (Building Research Establishment, Department of Environment, Watford, United Kingdom).

Paint coatings, including coil coated steel with alkyd melamine, steel with silicon alkyd paint, wood with alkyd paint system and wood with primer and acrylate (Norwegian Institute for Air Research, Lillestrøm, Norway).

Electric contact materials, including nickel, copper, silver and tin as coupons; Eurocard connectors of different performance classes (Swedish Corrosion Institute and Royal Institute of Technology, Stockholm, Sweden).

Environmental data storing, reporting and evaluation are the responsibility of the Norwegian Institute for Air Research.

The aim of this report is to present results of the painted systems withdrawn after 1 and 2 years of exposure. Some statistical treatments trying to evaluate the connection between the decay of the paint systems and environmental factors have been performed.

2 MATERIALS

The paint systems tested were:

- Coil coated steel panels with alkyd melamine (30 µm zinc + 20 µm alkyd melamine). System G.
- Steel panels coated with two layer silicon alkyd (80 µm). System H.
- Wood panels coated with two alkyd paint layers. System I.
- Wood panels coated with primer and acrylate (opaque stain). System K.

3 EVALUATION

The evaluation has followed the available ASTM standards and ISO standards. Annex 1 gives a discription of the different standards used. The types of damages evaluated are: General appearance, dirt, chalking, fungus, flaking, cracking, checking and gloss. For the paint-systems for metals damages around an artificial cut through the paint were evaluated. The results of the evaluation are given in Annex 2. Some small ajustments have been made in the evaluation scheme from the first to the second year.

The evaluation systems used in the ASTM and ISO standards for paint systems define parameters which may turn up to be visually connected. The general appearance results, which in our terms are an overall description of the visual impression, are so far more effected by the fungus results than by the other parameters evaluated. Some times it can be difficult to distinguish between the dark fungus and the dirt impression and a microscope is needed. Chalking may reduce the impression of dirt to some degree because of the white deterioration products formed on the surface.

After two years the main changes for the paint systems are found for the parameters general appearance, dirt, chalking, gloss and fungus. Effects along the cut in the steel systems also occurs. Very little of flaking, cracking and checking are observed. In the following pages the paint systems for steel and wood are discussed separately.

4 THE SERIES: COIL COATED STEEL WITH ALKYD MELAMINE (G) AND STEEL PANEL WITH SILICON ALKYD (H)

The test panels of these paint systems have a horizontal cut on the front surface. Type G has alkyd malamine on the front side only, but the H-type has silicon alkyd on both sides.

The panels at sites no. 34 and 35 have been placed with the front side down. The parameter "gen.app." therefore has been neglected for both systems, because the turning of the cut downwards makes it difficult to compare the front side with the other test sites. For the H-panels the paramters were evaluated on side facing up, except for the evaluation of damage in cut which of course, refer to the back side.

G-panels, coil coated alkyd malamine, with the specified coating only on one side were evaluated from the side facing down and the results are not comparable with the panels from the other test sites.

4.1 GENERAL APPEARANCE-DIRT

Generally spoken there are only small changes in appearance from one to two years of exposure.

4.1.1 Type G

On 24 of the sites the rating numbers (=RN) were still the same after 2 years. The greatest reductions in the rating numbers, 1 to 1.5 units, are observed at some of the urban and industry sites No. 8, 10, 22, 39.

There are still 9 sites with RN=9 for general appearance after 2 years, for dirt there even are 3 sites with a visual appearance of 10.. The lowest rating for general appearance is given to the Norwegian industrial test site NO22 RN=6 and for dirt to the urban site Venice in Italy with RN=7.

It appears that the rating for general appearance is only indirectly effected by the environmental parameters. Chalking and natural washing seems to effect the appearance considerably after 2 years. Some flaking in the edges is the main reason of the poor result for NOR 22.

The RN of dirt differs little from that of general appearance. We can see from Appendix 2 that one half of the panels have become cleaner after 2 years owing to chalking and natural washing. In Norway and Spain all the test panels have been cleaner after 2 years.

4.1.2 Type H

For 26 of the sites for the general appearance the RN was the same as for 1 year of exposure. Two rural sites have the highest ratings after 2 years. Toledo SPA 33 with RN=8.5 and Garmisch-Partenkirchen FRG 12 with RN=7.5. As much as 17 sites have got RN 7. Most effected were the panels CS3 (RN=4.5), ITA 15, 16, and USA 38 (all RN=5).

The panels with silicon alkyd seem to be more dirty than the alkyd melamine. More than the half of the panels have become more dirty after two years, and only 7 have been considered cleaner after the second year than after the first one.

In Holland, Czechoslovakia, Russia and Estonia all the panels have become more dirty during the exposure time.

4.2 CHALKING

Fig. 1 and 2 show a rather significant increase in chalking from 1 to 2 years of exposure. Particularily alkyd melamine (type G) was effected, but also the silicon alkyd showed attacks. For the second year's evaluation a more flexible tape (Scotch electric insulating tape, black) was used.

4.2.1 Type G

After 1 year all the panels had RN from 8 to 9.5 except the sites USA 38 and NOR 22 which have 5 and 5.5 respectively. After 2 years USA 38 and NOR 22 still have the same RN. Also

the rural site CS 2 was given RN 5, after two years. Very little chalking was found on panels CS 3, ITA 13, ITA 15, NOR 21, SWE 25 and 26, SPA 31 and 32, all RN 9. The only correlation between the environment measured at these sites and the chalking results found was for sunshine hours.

4.2.2 Type H

After 1 year the chalking level was about the same as for the G panels. Mean RN values for the two series were the same (8.8). The only panel which was significantly effected was USA 38 with RN 5. All the others had much less chalking.

All the panels showed chalking after two years, but generally less than for the G-panels. Yet, the two panels with most chalking of the H-series, USA 38 and NOR 22, had rating numbers below all panels in the G-series. Only the panels from CS 3 and SOV 34 were still nearly uneffected.

The correlation between chalking and gloss after 2 years was good for the H-series and some inferior for the G-series, perhaps mainly due to the difficult of using the standard method when measuring chalking.

4.3 GLOSS

Gloss measurements were carried out on all panels at one defined spot on the surface. The mean value from the three parallels is given in the tables in Annex 2. (Gloss value=GV). The gloss was measured both on unwashed and washed panels (see Annex 1 and 2).

Tabel 1 gives a comparison between the gloss of the two paint systems and between the first and second year results.

4.3.1 Type G

After one year of exposure all but NOR 22 had the highest gloss value (GV) after washing. After two years particularly samples with low values had higher gloss unwashed than washed. The lowest GV had: USA 38 (GV 1.7), NOR 22 (GV 2) and UK 29 (GV 2.4). The highest values unwashed had: SWE 25 (GV 27), FRG 10 (GV 24) and NOR 21 (GV 22). In Italy all the panels had the highest GV after washing. The reason seems to be the dirtyness of the panels.

4.3.2. Type H

Both sides of these were covered with the same paint, therefore also the back side was measured. After one year the highest GV on the front side was obtained after washing for all the panels except NOR 22. After two years 24 sites had the same trend as NOR 22 with less gloss after washing.

Some panels as CS 3 and POR 36, had a significant increase in gloss on front side when washed after 2 years of exposure.

As seen from table 1 most of the samples were little effected after the first year. After two years both paint systems were substantially effected on the front side but little on the back side. Dirt seems to effect the gloss results on the unwashed samples. However dirt may protect the samples against chalking. This may be the explanation for the good results for site CS 3 which had both little chalking and high gloss on washed surface.

The overall picture indicates that the same trend for all test sites. The sites with panels with high rating are in the best for both year and the low ratings are among the worst. Rural sites like USA 38, UK 29, CS 2 and industry site NO 22 are among the worst sites. The results of the back side for system H are different from the front side. Sites from Italy and The Netherlands were among the worst.

Table 1: A comparison between the one and two years' gloss results for the paint systems H and G.

		Exposed	
	Unexposed	Unwashed	Washed
Paint system H			
Front side mean at start	75.6		
mean after one year		55.3	67.2
mean after two years		38.4	37.8
Lowest value after one year		23 (USA 38)	25 (USA 38)
Lowest value after two years		5 (USA 38)	7 (USA 38)
Highest value after one year		69 (SWE 25)	82 (CS 3)
Highest value after two years		59 (SWE 25)	67 (SOV 34)
Paint system H			
Back side mean at start	75.6		
mean after one year		62.3	72.6
mean after two year		59.8	66.9
Lowest value after one year		56 (ITA 14)	68 (NL 19)
Lowest value after two years		49 (NL 19)	58 (ITA 16)
Highest value after one year		74 (CS 2)	78 (CS 2)
Highest value after two years		68 (CAN 37)	74 (SOV 34)
Paint system G			
Front side mean at start	34.8		
mean after one year		25.7	31.2
mean after two year		11.3	12.1
Lowest value after one year		10 (USA 38)	9 (NOR 22)
Lowest value after two years		1.7 (USA 38)	2.2 (NOR 22)
Highest value after one year		34 (SWE 25)	40 (OS 3)
Highest value after two years		27 (SWE 25)	31 (OS 3)

4.4 FUNGUS

The results of the evaluation of the fungi are shown in figure 3 and 4. No identification of the types has been done so far. In some very few cases a simple caracterization has been given, as notes. Silcon alkyd is more effected by fungi than alkyd melamine.

4.4.1 Type G

After one year some fungi were observed on 14 panels, and USA 38 and FIN 5 got the lowest RN=8. The next year fungi were found on 21 panels, and most on FIN 4 (where nothing was observed after one year), ITA 16, NL 17 and USA 38, all with RN 7.

4.4.2 Type H

23 panels were fungus infected after one year, and after two years the number was 24.

The lowest RN after one year had ITA 16 and USA 38 with RN 6. After two years USA 38 got RN 5 and in second place FIN 4 with RN 6.

It should be noted that on the panels from Spain and Portugal no fungus has been observed till now. This is also the case for Type G.

4.5 FLAKING, CRACKING AND CHECKING

A little flaking tendency on edge on the G-panel NOR 22 after two years of exposure is the only remark made with reference to these parameters.

4.6 DAMAGE LOCATED IN AND NEAR CUT

The type of damages codes in the columns 12, 13 and 14 should not be compared from one year to the next. This is because these parameters are not fixed with numbers but are more subjective. In the beginning it was difficult to choose an adequate level of strictness. In this case it made the evaluation of the first year results more strict than for the next year. The damage according to ASTM column 16 shall be compareable for

the first and second year. Particularely the steel system without zinc (H) showed attack in the cut, but all panels were effected after two years. Figure 5 and 6 show the results for the first and second year for damages along the cut.

As for the general appearance the results for the cut at the Russian and Estonian sites are not reported. The strongest effect was observed at the most polluted sites.

4.7 ADHESION

Insignificant changes in the H-series, and no change at all in the G series have been observed till now.

5 THE SERIES: WOOD PANEL WITH ALKYD PAINT (I) AND WITH PRIMER AND ACRYLATE (K)

5.1 GENERAL APPEARANCE

After two years most of the panels still had a good looking appearance. The interpretation of general appearance scale has been to give a general description of the visual performance (ref. Annex 1).

The panels have often been given a better RN after two years. The reason was mainly the effect of increased chalking. Two years of exposure have given little damage on the surface of most of the panels. The main effect is chalking and fungus. Dirt and fungus will often be the dominating parameters for determining of the RN the first years.

5.1.1 Type I

After two years of exposure two panels still have got the RN 10, that is the rural sites SPA 33 and CAN 37. Lowest RN

had: ITA 16 (RN 3), ITA 14, NL 18 and 20 (RN 5). 15 panels had better performance after two years of exposures compared to one year, 15 panels were worse. The worst appearance was associated with fungi attack.

5.1.2 Type K

Four panels have RN 10 after 2 years: FRG 12, NOR 23, CAN 37 and USA 38. The lowest values were found of sites effected by soildust. The general good appearance seen was caused by the chalking of the paint system. This is also illustrated by comparing the first and second year results, where 12 panels had lower ratiing, and 19 had higher rating after 2 years.

5.2 CHALKING

Chalking had increased considerably with time, and after two years all the panels were effected by chalking, type K more than type I. This is showed in fig. 7 and 8.

5.2.1 Type I

Considerable chalking after one year was only observed on the panel USA 38. After two years most chalking was observed at sites USA 38 (RN 5) and CS 1, FRG 7, 8, 9, 11, 12, NOR 22, SPA 33, POR 36, CAN 37 and USA 39, all with RN 6. Both clean and polluted sites had chalking.

5.2.2 Type K

The acrylate paint system (K) showed the same pattern as the alkyd system, both after one and two years. The main difference was that acrylate had more chalking than alkyd.

5.3 GLOSS

The structure (for example roughness) of the surface is one of the factors which effect the gloss measurements on wood panels. For three test sites the gloss has therefore been measured at definite spots on the surface before the exposure of the panels. After exposure, the panels were measured at the same points. One disadvantage was that the measurements had to be made on different panels for the first and second year. Since it seems to be a good correspondance between the change of gloss over time referred to the same locality, we have illustrated the changes of gloss with time for the sites CS 2, NOR 23 and SPA 31 in fig. 9.

From these figures we may conclude:

1. The loss of gloss occurs to a very high degree during the first and second year of exposure. Since this was true for relatively clean panels it is likely to think of chalking as the main reason for this, and that chalking consequently begins very soon after the start of exposure even at latitudes as far north as Norway (panel NOR 23).

2. The different steepness of the curves tells us that the fall in gloss values happens at a speed depending on the environment. The curves showed that fall in gloss value is faster in SPA 31 than at the two other stations.

3. After two years of exposure, the gloss value have reached almost the same level independently of the locality, the start value, and the paint system exposed. This minimum value of gloss seems to be near 2.

5.4 FUNGUS

The result of the quantification of fungi is shown in figures 10 and 11. The alkyd paint system was much more attacted by fungi than the acrylate system.

5.4.1 Type I

After one year of exposure it was observed fungi on 7 panels and after two years on 22 panels. The panels in Venice were worst both after one and two years (RN=3). The rural site Casaccia had RN=4 after two year and the two sites in Netherland Eibergen and Wynandsrade had RN=5. The fungi found were always of the dark surface type.

5.4.2 Type K

After the first year of exposure fungi were only observed on one panel, that was ITA 16. The next year we got 7 fungus-contaminated panels, but non had much of it. The lowest rating RN=9 was given to the very clean site UK 29 and to the industy site USA 39

5.5 FLACKING, CRACKING AND CHECKING

Very few damages have been observed the first year of exposure on the I series, and no remarks at all have been commented concerning the K series.

5.5.1 The type I

After two years abrasion of variable degree was observed on the top of highlying fibres. This will leave the fibers to open exposure to the environment and may be the start of more serious problems. Abrasion was observed at the sites CS1, FIN4, FRG9 and FRG12.

For some panels cracks were seen on highlying fibres. Venice ITA 16 urban and Eibergen NL 18 rural sites, had the strongest cracking. Small amount of cracks were observed on some other

sites (ITA 13, NL 19, 20 and UK 28). A special type of cracks, sigmoids were found on the industrial site Bottrop.

5.5.2 The type K

Very little damage has been discovered on the surfaces of the K series. Minor attacks of the sigmoid type were observed on sites ITA 14, 16 and NL 17. On site USA 39 checking of "the long line" type was observed.

6 DISCUSSION

The most dominating effect after two years for all paint systems was chalking. For chalking it is difficult to use the standard in the same way for the steel and wood systems, mainly because of the differences in the surface roughness. By using the more flexible black tape the comparison will be better but it will never be completely the same scale. Among the wood systems the acrylate seems to be most effected, and for the steel systems alkyd melamine.

Fungus is the other effect observed for all systems. The most effected ones are silicon alkyd used for steel and alkyd for wood. While the Italian sites Venice and Casaccia are the worst for wood paint, silicon alkyd is most effected at Research Triangle Park, North Carolina. The results seem to indicate that fungus develops most easily in humid air without to much SO_2. The fungicides used in paints today are often organic types and do not have the same all-round effect on all types of fungi. Even fungi which are closeby related can react differently. Therefore it is important to identify the types of fungi found on the surface. Plans for identification of the types of fungi observed have been discussed with the paint industry in Norway.

The third effect of interest, is observed on the steel systems at the cut. Particularly the silicon alkyd without any zinc is effected. The strongest effect is observed at the industry sites in Czechoslovakia. However, many of the background sites with very little pollution have a surprisingly low value (RN=5). Some of these have higher chloride concentrations like UK 29 and some like NOR 23 have high amount of precipitation, but for some of the background sites we have no obvious explanation.

7 STATISTICAL ANALYSIS

7.1 METHOD

The series of rating numbers for general appearance, chalking, fungus and cut damage were statistically analyzed by means of multiple linear regression. As independent (explanatory) variables, the yearly mean values of gases NO_2, SO_2 were taken together with mean value of ratio SO_2/NO_2, total time of wetness (TOW) in hours, precipitation amount in mm, mean value of pH and mean yearly temperature in grades Centigrade.

For modelling the rating numbers of fungus, a yearly mean value of total nitrogen was added.This was calculated as sum of NO_3-N and NH_4-N. For chalking, total sunshine hours were taken instead of TOW.

Two methods were used. First, rating numbers after one year of exposure were analyzed using the environmental variable values measured in the first season 1987/88, and the rating numbers after two years of exposure were related to the environmental variable values of the second year 1988/89. The second year of environmental data was chosen instead of a mean of the two investigation years, because more data were available.

To take advantage of the two consecutive years of data both for rating numbers and for the environmental variables, a new

variable was created to replace rating numbers for each material and for each type of damage. This variable was constructed as a difference between the maximum rating and rating the first year (10-RN 1 year), and rating the first year and rating after two years (RN 1 year - RN 2 years), and the data series were pooled. As environmental data, mean values resp. sums of TOW and sunshine hours for each respective year were used. This second method was not used for cut damage ratings.

In the regression analysis with pooled data, an indicator variable was added to the model that had value zero for the first year and one for the second year. Using this variable, it is possible to account for uneven rate of decay or change in the first and second years of exposure.

The resulting coefficient values are summarized in Annex 3 together with their standard errors and other model information. The results are summarized in Tables 2 and 3.

7.2 COIL COATED GALVANIZED STEEL WITH ALKYD MELAMINE (G)

For the second year of exposure data taken separately, a significant relation was found for fungus and cut damage. It was mainly the climatic parameters like TOW, precipitation and temperature that significanly reduced the ratings, however, the level of significance is low.

When analyzing the data for both years together and including the second year indicator in the regression, significant relations were found for general appearance, dirt and chalking. A lower rate of decay (difference between status the following years) was observed for the second year for general appearance and dirt, and higher difference is observed for chalking. Ratio between SO_2 and NO_2 seemed to affect negatively both general appearance and dirt. With higher value of sunshine, less difference was observed for chalking.

7.3 STEEL PANEL WITH SILICON ALKYD (H)

The data for the second year of exposure seemed to indicate decay due mainly to climatic parameters (TOW for general appearance, sunshine and precipitation for chalking, precipitation for fungus). Higher values of SO_2 seemed to influence the general appearance negatively, higher total nitrogen seemed to improve rating number of fungus. For cut damage, SO_2 seemed to influence the rating negatively, while NO_2, raio SO_2/NO_2 and temperature seemed to have a positive correlation with the ratings.

Using the two year-series in one regression with the additional second year indicator, a significant relation was found for general appearance for the ratio SO_2/NO_2, with less difference in ratings after the second year of exposure than after the first. In addition, SO_2 and amount of precipitation affected negatively general appearance on a low level of significance. Higher ratio between SO_2 and NO_2 and TOW seemed to lead to higher decay measured by dirt, but the significance level for TOW was low.

7.4 WOOD PANEL WITH ALKYD PAINT (I)

No significant relations were found for ratings of general appearance and dirt.

For chalking, the two types of analysis gave similar results. Higher ratings appeared with higher pH and lower ratings with increase in temperature. The decay in chalking seemed less the second year. In addition, higher value of ratio between SO_2 and NO_2 the second year seemed to decrease the rating.

For fungus, the model for the second-year data was singificant on low level of significance. When the data were taken together, the ratings for fungus seemed to decrease more rapily the second year. Higher TOW, amount of precipitation and pH contributed to this worsening.

7.5 WOOD PANEL PAINTED WITH PRIMER AND ACRYLATE PAINT (K)

The system K seems to be negatively affected by NO_2 when looking at general appearance and dirt. For these two types of evaluation, the decay seemed lower the second year. When looking on chalking, the results differ between the two statistical models used. The temperature contributed significantly to the decay when the data are pooled, and with NO_2 positively and sunshine negatively correlated with ratings when the second year data were used. The score for chalking seemed to show more decrease after the second year. For fungus, no significant relation was found.

7.6 CONCLUSION OF THE STATISTICAL ANALYSES

As a basis for the statistical analysis, the mean values of the environmental variables were used. Except for ratio between SO_2 and NO_2, no other type of index was created. Thus, mean values were considered representative for the whole year, and we restricted ourselves mainly to the existing direct measurements. This may not be appropriate for constructing dose respons when material damage is to be investigated. It may also be necessary to expose the materials for longer time to be able to observe an effect.

However, the statistical analysis indicated that for certain types of damage for individual materials, both the climatic and air pollution parameters influenced the status of the exposed panels. These influences were not quantified, as it is felt that longer series is needed to obtain more relevant results.

Table 2: Evaluation of decay of painted surfaces - second year of exposure.*
Models explaining variability on at least 0.05 significance level.

	General appearance	Dirt	Chalking	Fungus	Cut damage
G	N.S.	N.S.	N.S.	[TOTN ↘, PREC ↘, TOW ↘, TEMP ↘]^{1}	[TOW ↘, PREC ↘]^{1}
H	TOW ↘ SO_2 ↘	[TOW ↘]^{2}	PREC ↘ PREC ↘	[TOTN ↘, PREC ↘]^{1}	SO_2 ↗ NO_2 ↗ SO_2/NO_2 ↗ TEMP ↗
I	N.S.	N.S.	pH ↗ TEMP ↗ SO_2/NO_2 ↘	[TOTN ↗, PREC ↘, TOW ↘]^{1}	-
K	NO_2 ↘	NO_2 ↘	[NO_2 ↗]^{2} [SUN ↘]^{2}	N.S.	-
Variables in the model	SO_2 NO_2 SO_2/NO_2 ratio TOW PRECIP. (mm) pH TEMPERATURE	SO_2 NO_2 SO_2/NO_2 ratio TOW PRECIP. (mm) pH TEMPERATURE	SO_2 NO_2 SO_2/NO_2 ratio TOW PRECIP. (mm) pH TEMPERATURE	SO_2 NO_2 SO_2/NO_2 ratio TOW PRECIP. (mm) pH TEMPERATURE TOTN (total N)	SO_2 NO_2 SO_2/NO_2 ratio TOW PRECIP. (mm) pH TEMPERATURE

1) Model significantly explains variability on level <0.1.
2) Model significantly explains variability on 0.05 level, but the individual cofficients are significantly nonzero only on 0.10 level.
* Only variables with coefficients significantly nonzero (on 0.1 level at least) are indicated, for models that explain the variability in rating numbers significantly.

Symbols:
N.S. Model does not explain the variability in rating numbers sufficiently.
↘ With increase in the environmental variable decrease in rating number (worsening).
↗ With increase in the environmental variable increase in rating number (bettering).

Table 3: Evaluation of decay of painted surfaces - first and second year of exposure.*
Models explainin variability on at least 0.05 significance level.

	General appearance	Dirt	Chalking	Fungus	Cut damage
G	2YR ↗ PREC ↗ SO_2/NO_2 ↘	2YR ↗ SO_2/NO_2 ↗	2YR ↘ SUNSH ↗	N.S.	NOT EVALUATED
H	2YR ↗ PREC ↘ 3 SO_2 ↘ 3	2YR ↗ TOW ↘ 3 SO_2/NO_2 ↘	N.S.	N.S.	
I	N.S.	N.S.	2YR ↘ pH ↗ TEMP ↗	2YR ↘ TOW ↘ PREC ↘ pH ↘	
K	2YR ↗ NO_2 ↗ SO_2/NO_2 ↘ 3	2YR ↗ NO_2 ↗ SO_2/NO_2 ↘ 3	2YR ↘ TEMP ↘	N.S.	
Variables in the model	SO_2 NO_2 SO_2/NO_2 ratio TOW PRECIP. (mm) pH TEMPERATURE 2 year ind. 2YR	SO_2 NO_2 SO_2/NO_2 ratio TOW PRECIP. (mm) pH TEMPERATURE 2 year ind. 2YR	SO_2 NO_2 SO_2/NO_2 ratio SUNSH. PRECIP. (mm) pH TEMPERATURE 2 year ind. 2YR	SO_2 NO_2 SO_2/NO_2 ratio TOW PRECIP. (mm) pH TEMPERATURE TOTN (total N) 2 year ind 2YR	

1) Model significantly explains variability on level <0.1.
2) Model significaltly explains variability on 0.05 level, but the individual coefficients are significantly nonzero only on 0.10 level.
3) Coefficient is significantly nonzero on level <0.1.

* Only variables with coefficients significantly nonzero (on 0.1 level at least) are indicated, for models that explain the variability in rating numbers significantly.

Symbols:
N.S. Model does not explain the variability in rating number sufficiently.
\ With increase in the environmental variable decrease in rating number (worsening).
/ With increase in the environmental variable increase in rating number (bettering).

ANNEX 1

Paint evaluation

1 GENERAL COMMENTS TO THE EVALUATION

The evaluation has followed international standards where standards have been available. All evaluations were made from three parallels.

We have chosen to follow the ASTM-standards since their standards cover most of the parameters evaluated. Even when ISO-standards were available the similar ASTM-standards were prefered. The ISO-standards were used for some rating with a transformation to the 1-10 scale. The transformation is shown in Table 1.

Table 1:

Rating ASTM	Rating ISO	Intensity of change
10	0	Unchanged
9	1	Very slight
8		
7	2	Slight
6		
5	3	Moderate (reparation may be needed)
4		
3	4	Considerable
2		
1	5	Severe

Some of the columns give descriptions of the deterioration pattern seen and special scales are made for these columns.

Since nearly all evaluations made for paint systems to some degree will be subjective, we have made coloured photo-standards for the rating using a selection of the exposed samples. The same series of samples will always be used and extensions will be made if necessary. This is done to prevent movements and changes in the rating scale.

2 COMMENTS TO THE SCHEME

Column 1

Countries which participate in the project.

Column 2

Number-code for the test sites.

Column 3

GENERAL APPEARANCE (ASTM D 1150-55)

In this report the rating shall give information about the overall picture of the test samples. To interpret the rating of the general appearance concideration must be taken to the rest of the evaluations made. At rating 5 action for special treatment or repainting may be taken. After one year of exposure there was a strong connection between general appearance and dirt, and after two years with dirt or fungus.

Note that interpolation like 9.5. 8.5 and so on is used for the rating.

Column 4

DIRT (ASTM D 3719-87)

Photo-standards have been made for all four paint systems. It is sometimes difficult to distinguish between dirt and fungus since the fungus is of the black surface type. After we have started to use a transparent tape for moving a sample from the paint surface to a glass plate and use the microscope, distinguishing between fungus and dirt has become much easier.

Column 5

CHALKING (ASTM 4214-82 and ISO 4628/6)

The test is made by use of tape (Scotch Magic no. 810). The tape (ca. 5 cm) was pressed against the painted surface and pulled off again. By sticking the tape on a black cardboard the calking appeared and a reference system was made. When the rating 1 is reached, the tape cannot receive more "chalking", but the chalking, may still grow deeper in the surface of the sample. The second year we have used a black electrotape Scotch Super 88 sticked to a transparent plastic card, since we wished to have a more flexible tape for the test of the wood panels.

The results from the paint system G were used as a standard.

Column 6

FUNGUS (ASTM D 3274-82 and ASTM D 4610-86)

The fungus-hyphae are small and we have made a special evaluation rating for inspection in the microscope.

Magnification used: 10-20
Inspected area : approximately 1.0 cm^2

Rating	Description of attack
10	No attack
9.5	2-3 places with traces of fungus-hyphae
9	Traces of fungus-hyphae several places
8	Fungi in about 50% of the inspected areas
7	Fungi can be seen in almost 100% of the areas
6	Fungi all over the sample. Moderate amounts

Column 7-9

FLAKING (ASTM D 772-86 and ISO 4628/5)
CRACKING (ASTM D 661-86 and ISO 4628/4)
CHECKING (ASTM D 660-44 and ASTM D 660/87)

Some wood panels show types of checking, long line and sigmoid types, the sigmoid type is marked by "sig" in column 22. The damage may be difficult to observe without the use of microscope.

Column 10-11

The columns are free.

Possible use is BLISTERING (ISO-4628/2) and RUSTING (ISO-4628/3).

Column 12

Used only for painted metals.

BLISTERING NEAR CUT: Special scale.

Rating	Defects
Open space	No blisters
(b)	Few blisters
b	Moderate amount
bB	Considerable amount
B	The area dominated by blisters

Column 13

Used only for painted metals.

FLAKING NEAR CUT: Special scale.

Rating	Defects
Open space	No flacking
(f)	Slight flacking
f	Moderate flacking
fF	Considerable flacking
F	The area dominated by flacking

As a part of the evaluation of flacking, tape (Scotch Ruban Adhesif) was used to pull off the flacked area around the cut.

Column 14

Used only for painted metals.

RUST IN CUT: Special scale.

Rating	Defects
Open space	No rust
(r)	Slight corrosion
r	Moderate corrosion
rB	Considerable corrosion
R	Severe corrosion

Column 15

Used only for painted metals.

DAMAGE AREA: Not used.

Plan is made to measure the damage area around cut by use of image analysis.

Column 16

Used only for painted metals.

DAMAGE (ASTM D 1654-79a)

Recording of loss of paint as mean creepage in mm from the cut. Differences in the corrosion attack are often seen and notes are often given in column 22 (notes). The codes used are:

d = discontineous: Damages around the cut with parts without damages.
s = spotty: Occasional damages around the cut.

Column 17-20

GLOSS
Gloss instrument used: Glossmaster/Erichsen.

Measurements of the light reflection in % at 60^0 angle.

Measurements were made both unwashed and washed. The washing was done by water and synthetic soap using paper towel for washing and drying.

For the painted steel systems, G and H, the results given are the mean value of three measurements. For the painted wood systems, I and K, the results given are the middle value of three measurements.

Column 21

ADHESION (Cross-cut ISO 2409)

The cross-cut was only used for the painted metals. The adhesion test was only made with panels from the most detoriated places.

Reference values for unexposed paints were (in ASTM-ratings):

Material G	Coil coated galvanized steel	= 10
Material H	Silicon alkyd	= 6

Adhesion test on painted wood was not successful. Pull off test like ASTM D 4541 always gave adhesion failure in the wood in stead of in the interface between paint and wood.

Column 22

NOTES: The numbers refer to the actual column.

Codes used for the second year evaluation are:

rw = flow of rustwater from the cut
sig.= (see column 7-9)
d = (see column 16)
s = (see column 16)

ANNEX 2

Figures and tables

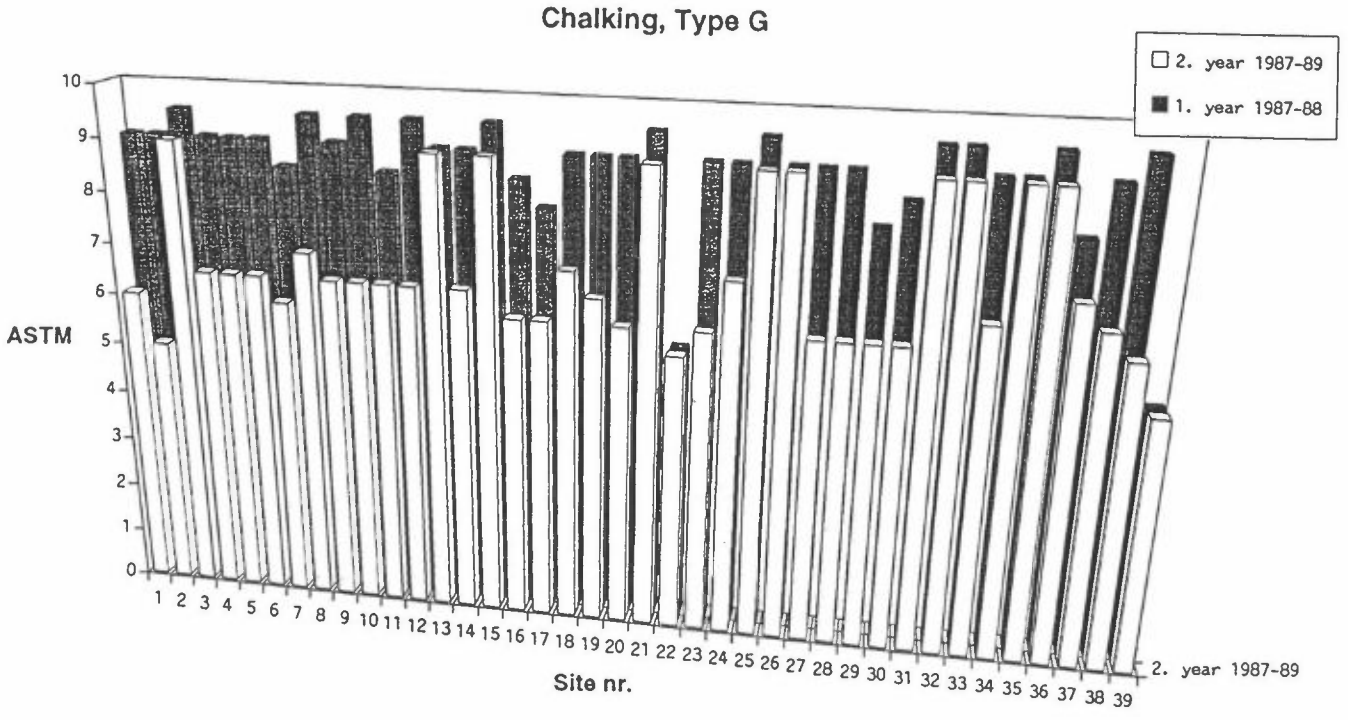

Figure 1: Chalking results for alkyd melamine paint after 1 and 2 years.

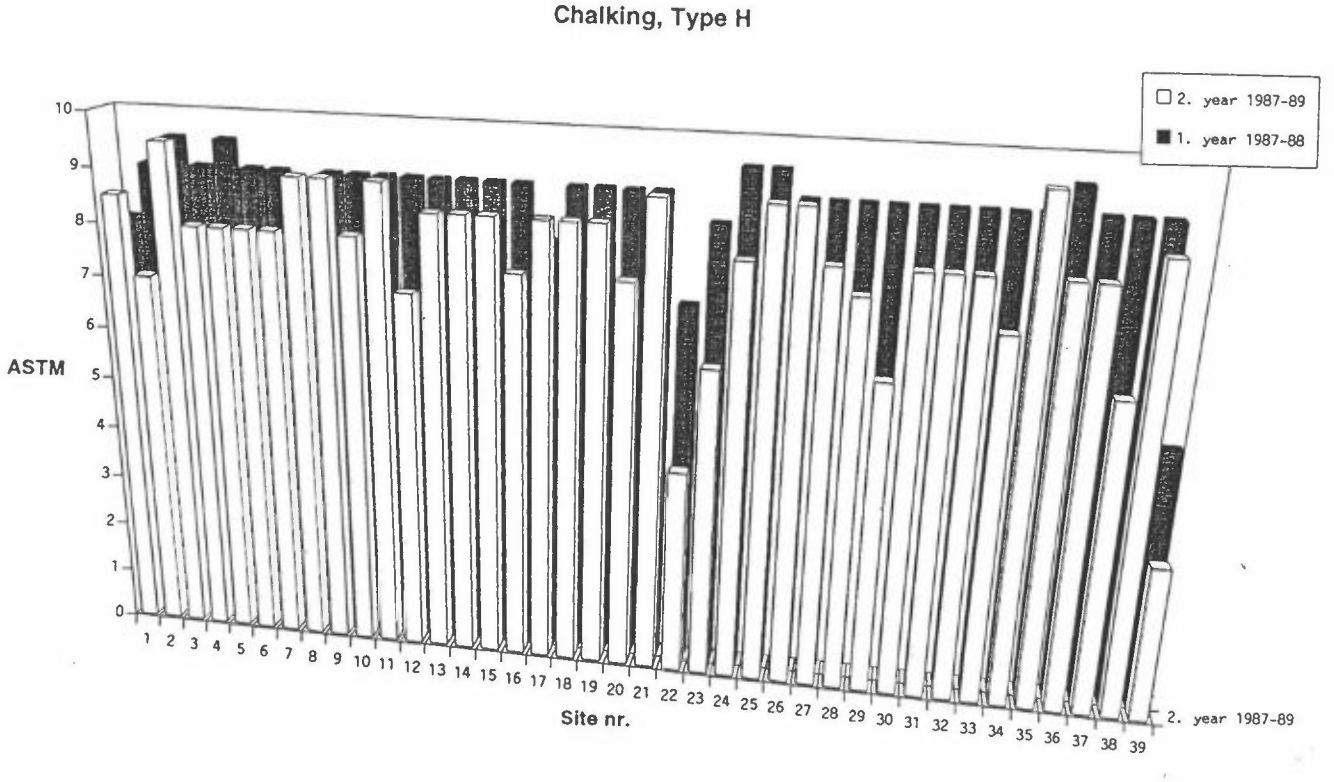

Figure 2: Chalking results for silicon alkyd paint after 1 and 2 years.

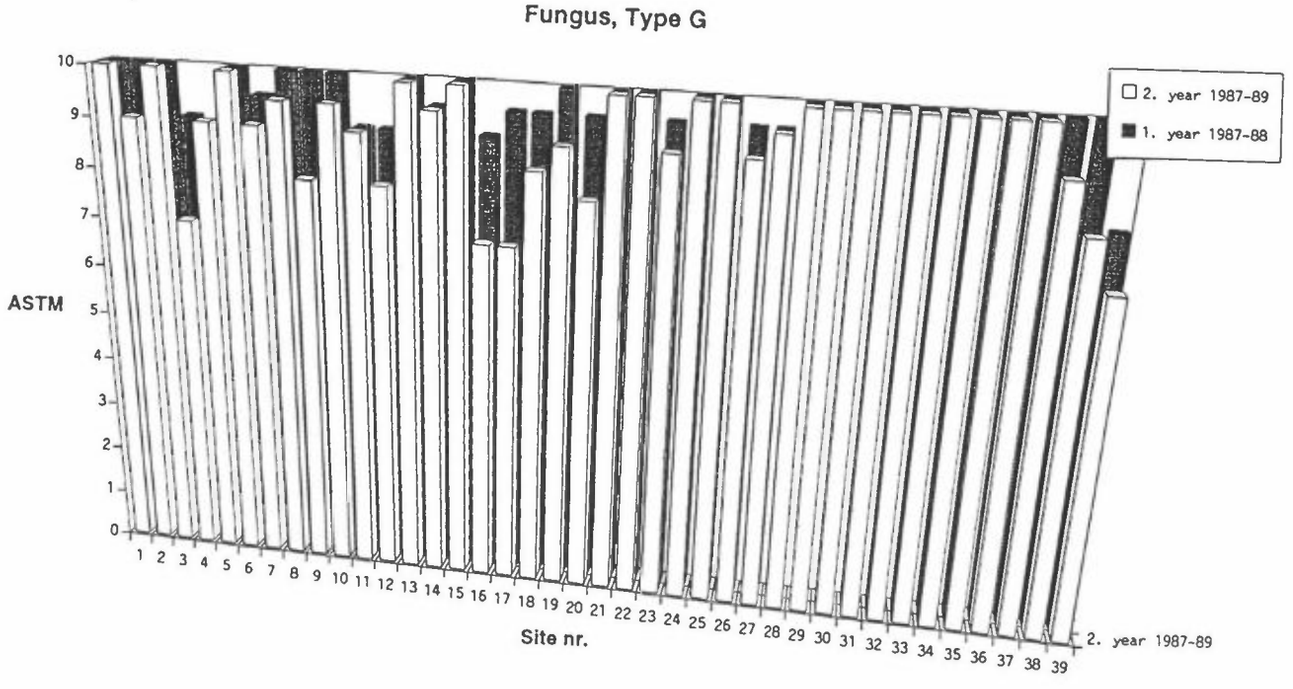

Figure 3: Fungi results for alkyd melamine paint after 1 and 2 years.

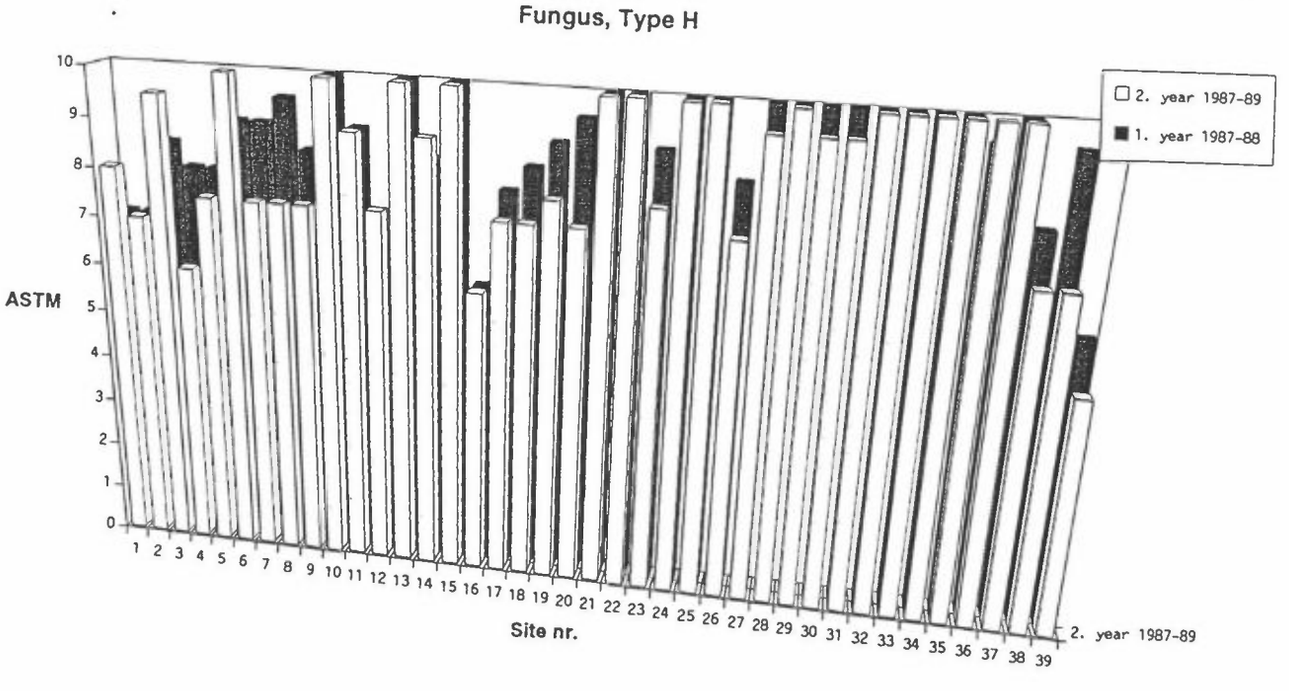

Figure 4: Fungi results for silicon alkyd paint after 1 and 2 years.

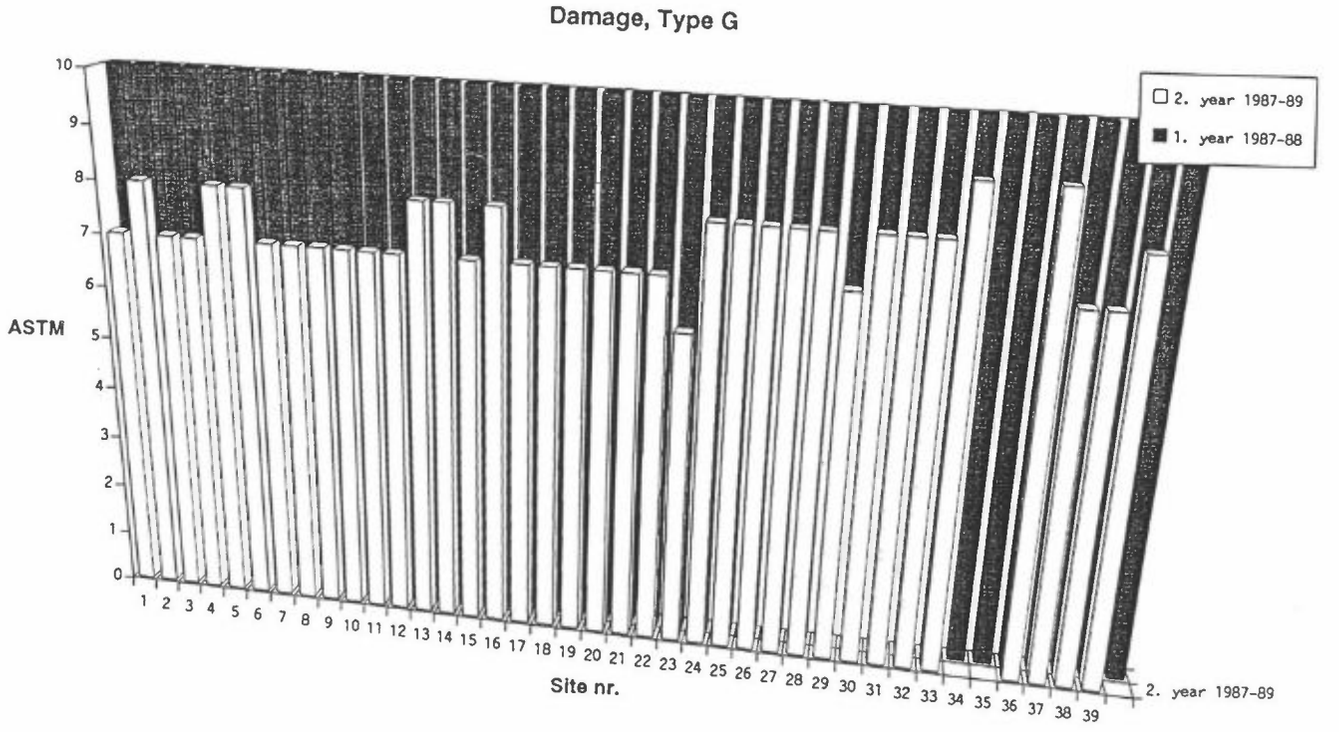

Figure 5: Results of the damage in and near the cut for the alkyd melamine paint after 1 and 2 years.

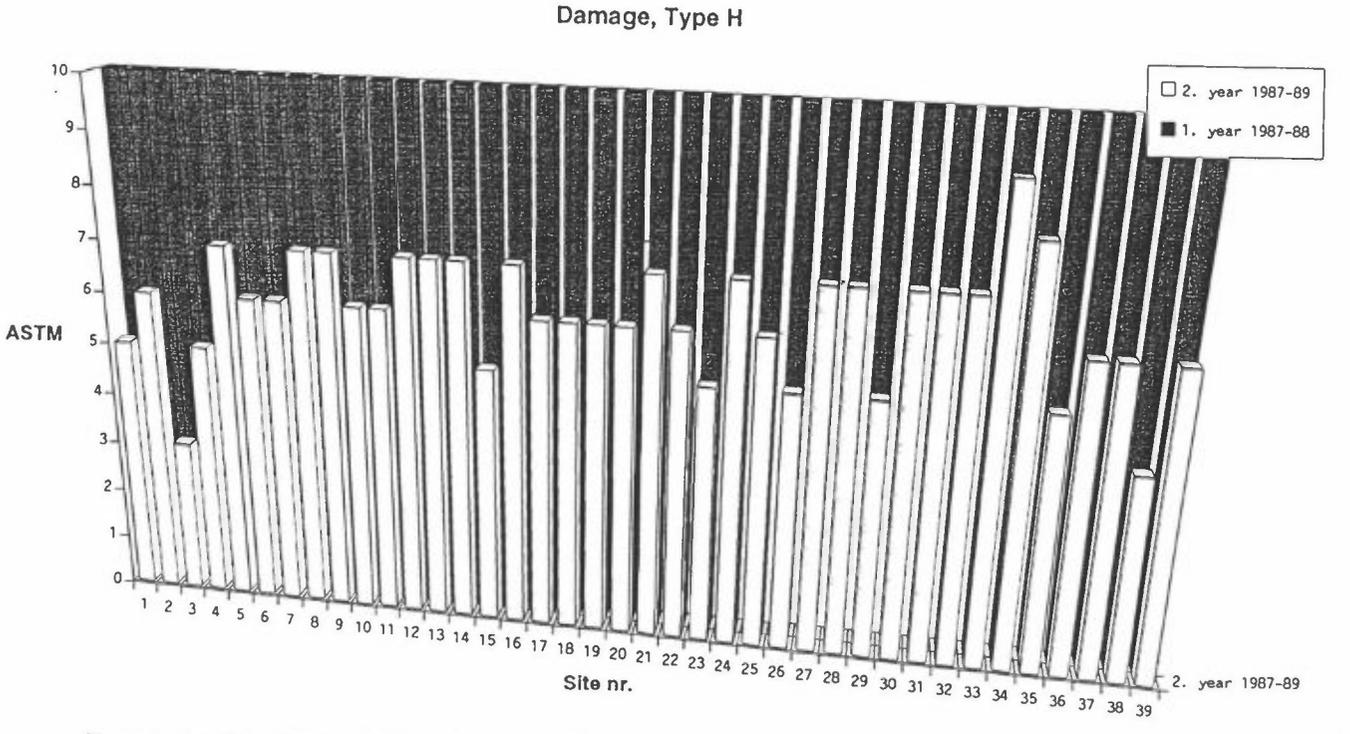

Figure 6: Results of the damage in and near the cut for silicon alkyd paint after 1 and 2 years.

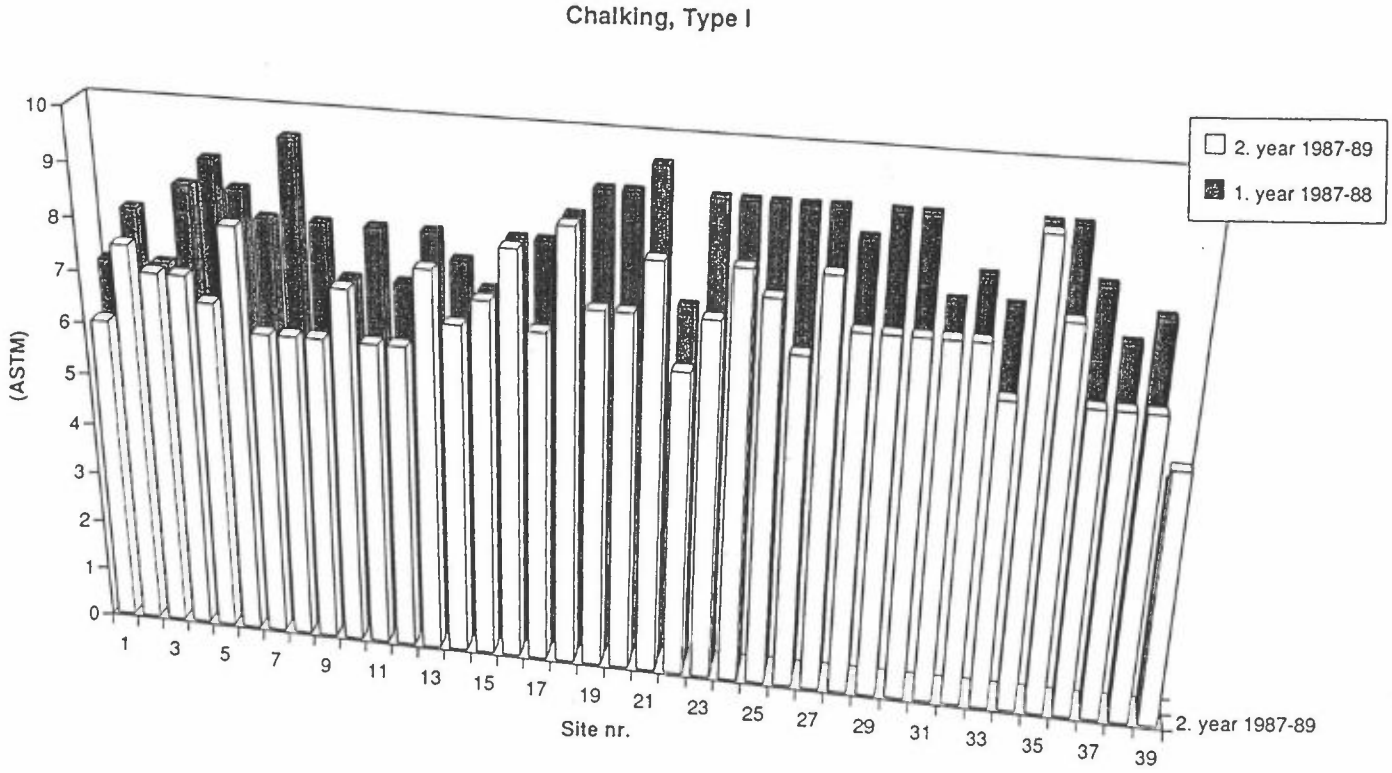

Figure 7: Chalking results for alkyd paint after 1 and 2 years.

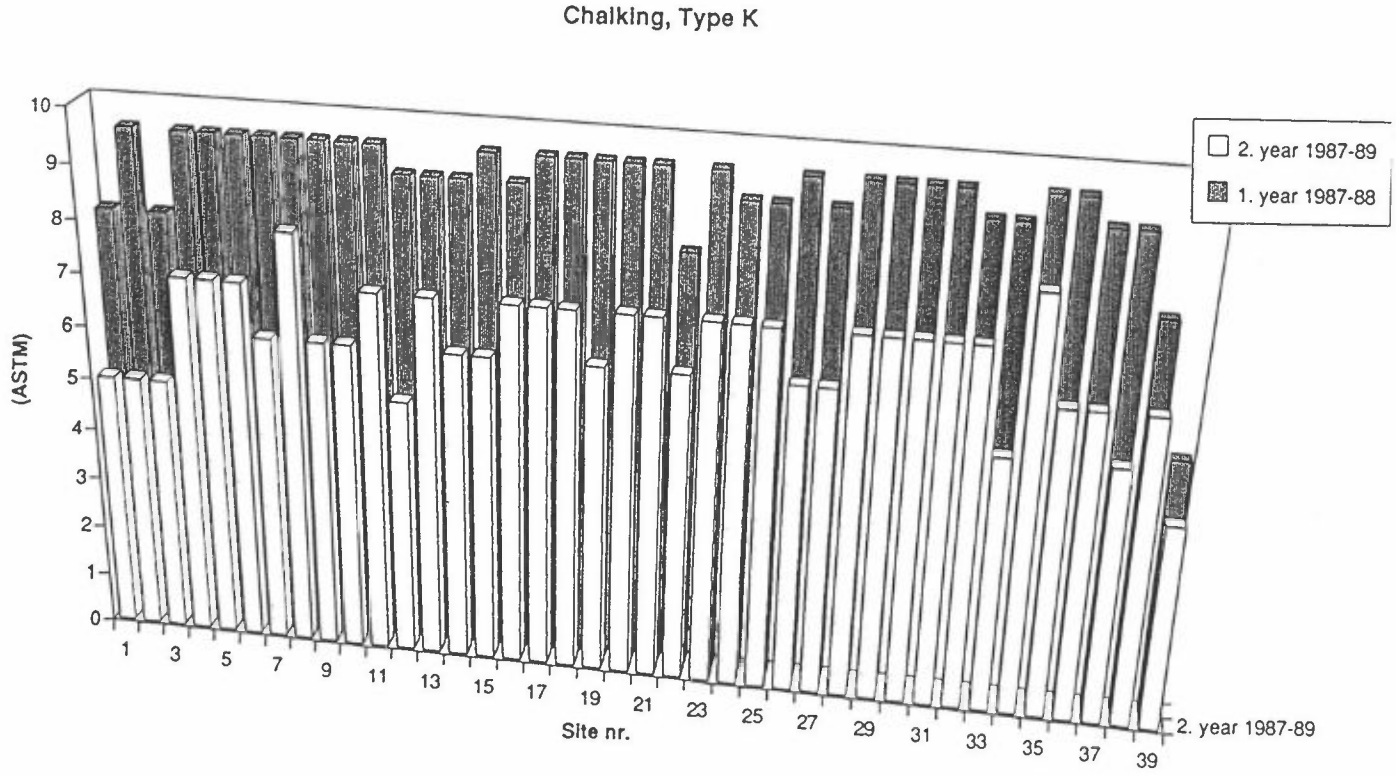

Figure 8: Chalking results for acrylate paint after 1 and 2 years.

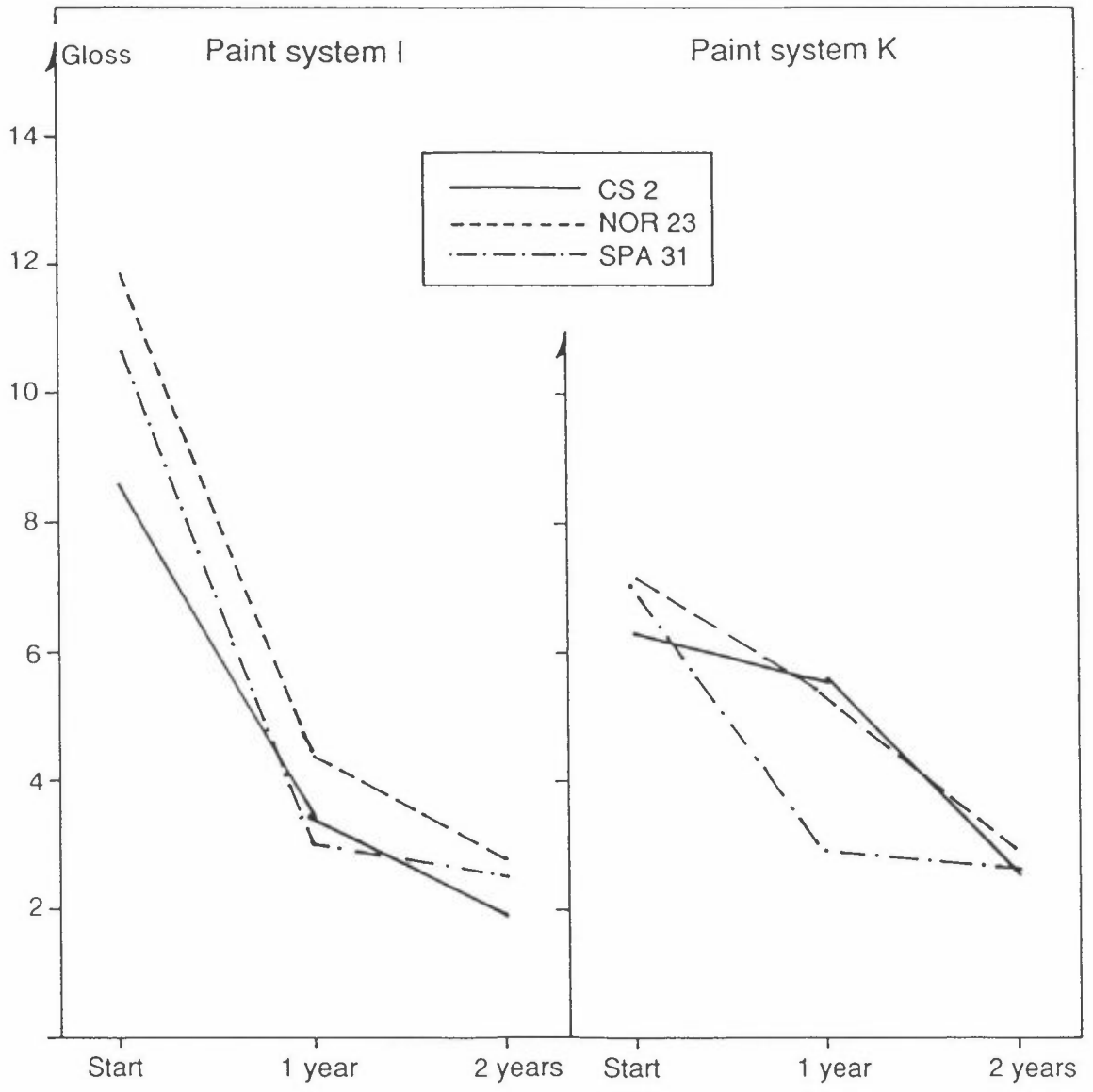

Figure 9: Gloss results for the test sites CS 2 Kasperske Hory, NO 23 Birkenes and SPA 31 Madrid after 1 and 2 years.

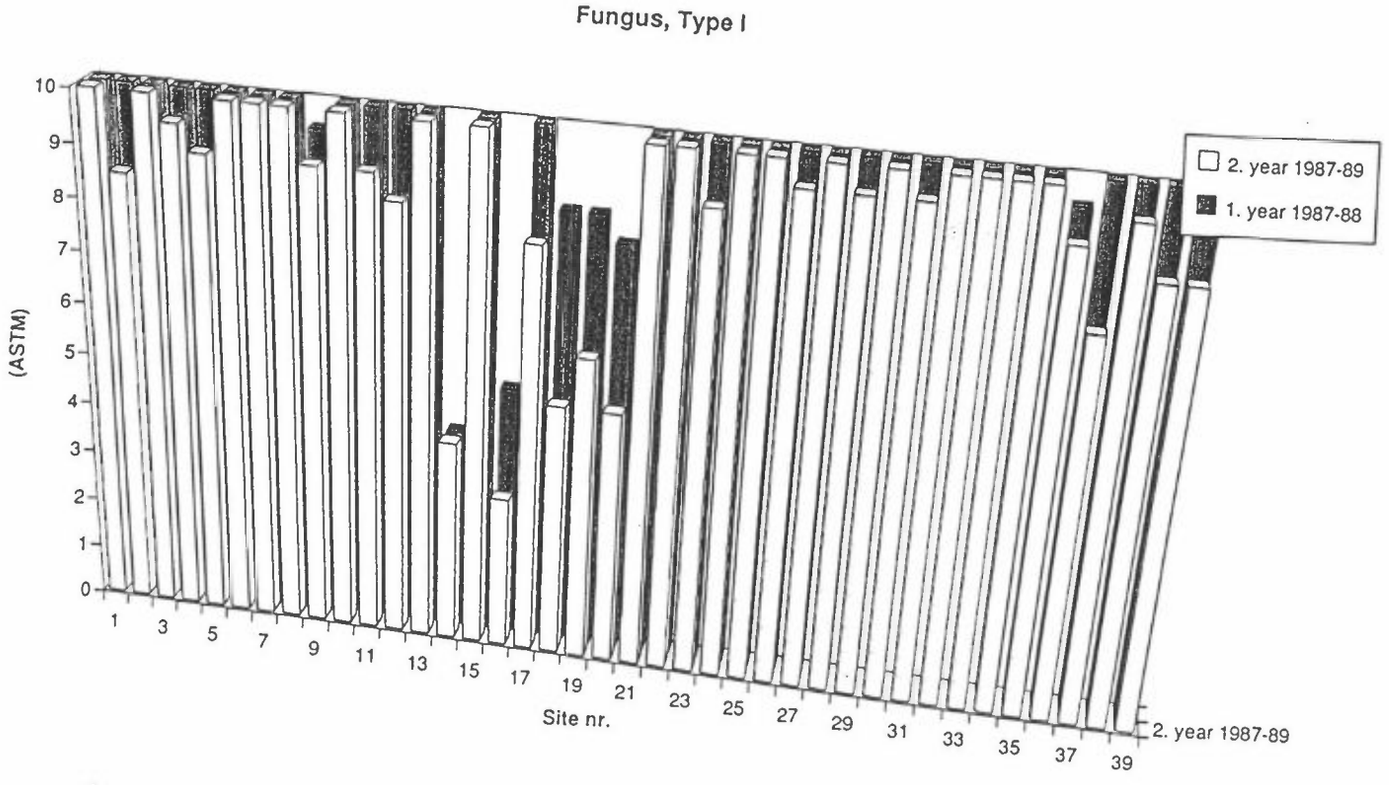

Figure 10: Fungi results for alkyd paint after 1 and 2 years.

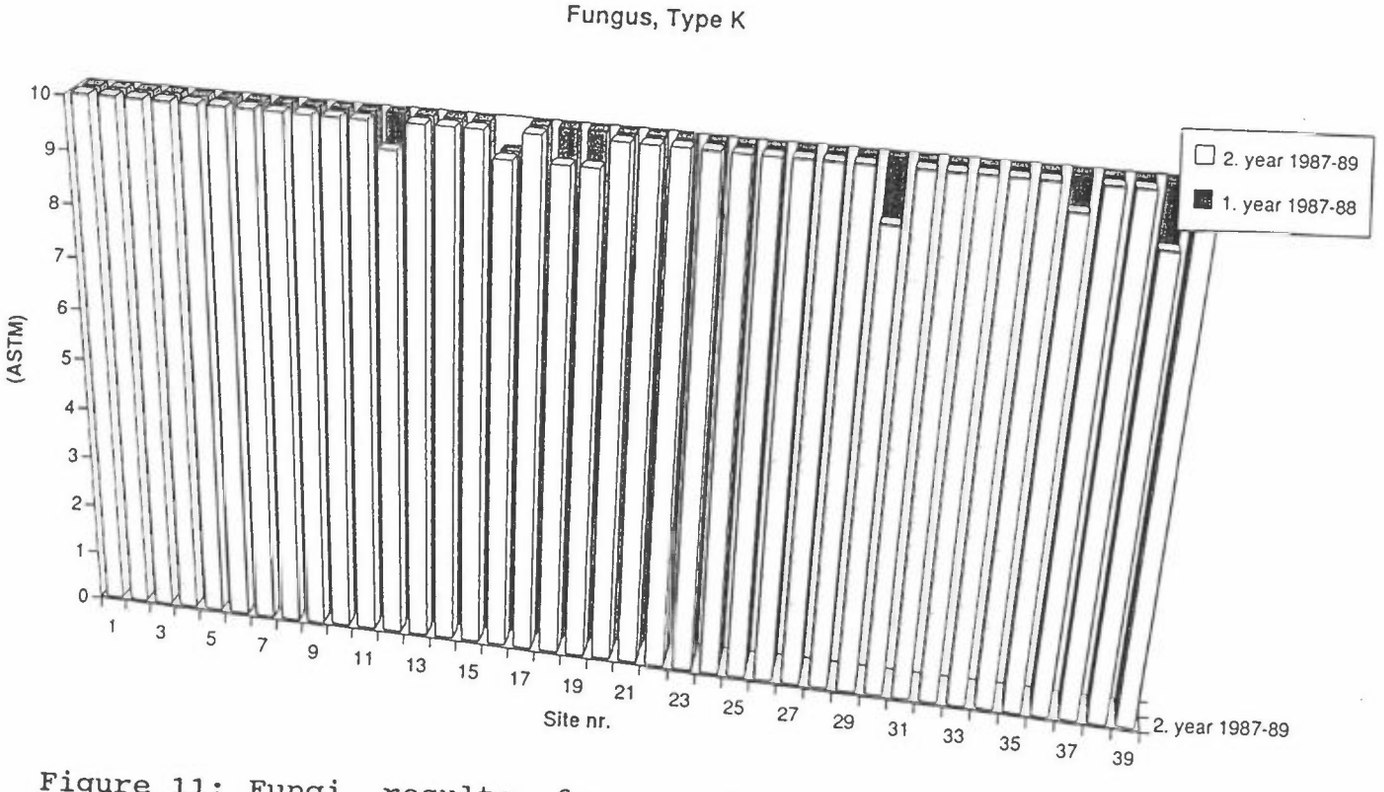

Figure 11: Fungi results for acrylate paint after 1 and 2 years.

Table 1: The results of 1 year's exposure of coil coated steel with alkyd melamine coating.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
G 1	87/88	9.0	8.5	9.0	10.0	10.0	10.0	10.0					(r)		8.0	26.0	34.0			
G 2	87/88	8.5	9.0	9.0	10.0	10.0	10.0	10.0			(b)		(r)		9.0	23.0	26.0			
G 3	87/88	8.0	7.5	9.5	10.0	10.0	10.0	10.0					(r)		8.0	25.0	40.0			10.0
G 4	87/88	8.5	8.5	9.0	9.0	10.0	10.0	10.0					(r)		8.0	31.0	37.0			
G 5	87/88	8.5	7.5	9.0	8.0	10.0	10.0	10.0			(b)		(r)		9.0	29.0	34.0			
G 6	87/88	8.5	8.5	9.0	10.0	10.0	10.0	10.0			(b)		(r)		8.0	31.0	37.0			
G 7	87/88	9.0	9.0	8.5	9.5	10.0	10.0	10.0			b		(r)		8.0	29.0	34.0			
G 8	87/88	8.5	8.0	9.5	10.0	10.0	10.0	10.0			b	(f)	(r)		8.0	31.0	36.0			
G 9	87/88	8.5	8.5	9.0	10.0	10.0	10.0	10.0			b	(f)	(r)		8.0	26.0	32.0			
G10	87/88	8.5	8.0	9.5	10.0	10.0	10.0	10.0			b		(r)		8.0	26.0	31.0			
G11	87/88	8.5	7.5	8.5	9.0	10.0	10.0	10.0			b		(r)		8.0	23.0	27.0			
G12	87/88	9.0	9.0	9.5	9.0	10.0	10.0	10.0			(b)		(r)		8.0	30.0	36.0			
G13	87/88	7.0	7.0	9.0	10.0	10.0	10.0	10.0			(b)		(r)		9.0	17.0	38.0			
G14	87/88	8.5	9.0	9.0	9.5	10.0	10.0	10.0			(b)		(r)		8.0	22.0	37.0			
G15	87/88	7.0	6.5	9.5	10.0	10.0	10.0	10.0			(b)		(r)		8.0	27.0	39.0			10.0
G16	87/88	6.5	6.0	8.5	9.0	10.0	10.0	10.0			(b)		(r)		9.0	19.0	37.0			
G17	87/88	8.0	8.0	8.0	9.5	10.0	10.0	10.0			(b)	(f)	(r)		8.0	25.0	30.0			
G18	87/88	7.0	8.5	9.0	9.5	10.0	10.0	10.0			(b)		r		8.0	32.0	37.0			
G19	87/88	8.5	8.5	9.0	10.0	10.0	10.0	10.0			b		r		8.0	27.0	31.0			
G20	87/88	9.0	9.0	9.0	9.5	10.0	10.0	10.0			(b)		(r)		8.0	26.0	31.0			
G21	87/88	8.5	8.0	9.5	10.0	10.0	10.0	10.0			(b)	(f)	(r)		8.0	29.0	35.0			
G22	87/88	7.5	9.0	5.5	10.0	10.0	10.0	10.0			b	(f)	(r)		7.0	12.0	9.0			10.0
G23	87/88	8.0	9.5	9.0	9.5	10.0	10.0	10.0			b	f	r		8.0	30.0	30.0			10.0
G24	87/88	9.0	9.5	9.0	10.0	10.0	10.0	10.0			(b)	f	(r)		8.0	32.0	37.0			
G25	87/88	8.0	7.5	9.5	10.0	10.0	10.0	10.0			(b)	f	(r)		8.0	34.0	38.0			

Cont.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
G26	87/88	9.0	8.5	9.0	9.5	10.0	10.0	10.0			b		(r)		9.0	33.0	37.0			
G27	87/88	8.0	8.5	9.0	9.5	10.0	10.0	10.0			b		(r)		8.0	27.0	33.0			
G28	87/88	9.5	9.5	9.0	10.0	10.0	10.0	10.0			b		(r)		8.0	27.0	30.0			
G29	87/88	8.0	9.5	8.0	10.0	10.0	10.0	10.0			b		r		8.0	20.0	20.0			
G30	87/88	9.0	9.0	8.5	10.0	10.0	10.0	10.0			b		(r)		8.0	23.0	26.0			
G31	87/88	8.0	7.0	9.5	10.0	10.0	10.0	10.0					(r)		9.0	24.0	36.0			
G32	87/88	7.5	7.0	9.5	10.0	10.0	10.0	10.0			b		(r)		8.0	24.0	36.0			
G33	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0					(r)		9.0	23.0	30.0			
*G34	87/88		8.0	9.0	10.0	10.0	10.0	10.0					(r)		10.0			27.0	35.0	
*G35	87/88		9.5	9.5	10.0	10.0	10.0	10.0					(r)		10.0			36.0	38.0	
G36	87/88	8.0	8.0	8.0	10.0	10.0	10.0	10.0			b		(r)		9.0	19.0	32.0			
G37	87/88	9.5	9.5	9.0	10.0	10.0	10.0	10.0			(b)		(r)		9.0	29.0	33.0			
G38	87/88	9.5	9.0	5.0	8.0	10.0	10.0	10.0			b	f	(r)		9.0	10.0	12.0			10.0
G39	87/88	8.0	8.0	9.5	10.0	10.0	10.0	10.0					(r)		8.0	29.0	34.0			10.0

*: The evaluation has been carried out on the back side for all the parameters.

Table 2: The results of 1 year's exposure of steel panels with silicon alkyd paint.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
H 1	87/88	6.0	8.0	8.0	7.0	10.0	10.0	10.0			b	f	R		6.0	60.0	77.0	67.0	76.0	6.0
H 2	87/88	7.0	9.0	9.0	7.0	10.0	10.0	10.0			b		R		9.0	55.0	65.0	74.0	78.0	
H 3	87/88	5.0	7.0	9.5	8.5	10.0	10.0	10.0			b	f	R		5.0	49.0	82.0	67.0	77.0	6.0
H 4	87/88	7.0	8.0	9.0	8.0	10.0	10.0	10.0			b		R		7.0	63.0	78.0	67.0	75.0	
H 5	87/88	7.0	7.0	9.5	8.0	10.0	10.0	10.0			b		R		7.0	61.0	69.0	71.0	75.0	
H 6	87/88	7.0	9.0	9.0	9.0	10.0	10.0	10.0			b	f	R		7.0	64.0	76.0	65.0	75.0	6.0
H 7	87/88	6.5	9.0	9.0	9.0	10.0	10.0	10.0			bB		R		7.0	60.0	71.0	67.0	73.0	5.0
H 8	87/88	7.5	6.0	8.0	9.5	10.0	10.0	10.0			b		R		9.0	66.0	78.0	68.0	74.0	
H 9	87/88	7.5	6.0	9.0	8.5	10.0	10.0	10.0			b	(f)	R		9.0	62.0	73.0	70.0	76.0	
H10	87/88	6.0	7.0	9.0	10.0	10.0	10.0	10.0			b	f	R		7.0	60.0	72.0	63.0	72.0	5.0
H11	87/88	7.0	7.0	9.0	9.0	10.0	10.0	10.0			b		R		7.0	55.0	66.0	63.0	70.0	
H12	87/88	8.0	9.0	9.0	7.0	10.0	10.0	10.0			(b)		R		9.0	63.0	68.0	70.0	74.0	
H13	87/88	6.5	5.0	9.0	10.0	10.0	10.0	10.0			(b)		R		8.0	37.0	70.0	57.0	61.0	
H14	87/88	7.0	6.0	9.0	8.5	10.0	10.0	10.0			b		R		7.0	45.0	65.0	56.0	69.0	
H15	87/88	5.0	5.0	9.0	10.0	10.0	10.0	10.0			bB	f	R		5.0	58.0	74.0	65.0	71.0	5.0
H16	87/88	5.0	4.0	9.0	6.0	10.0	10.0	10.0			b	(f)	R		7.0	34.0	60.0	59.0	71.0	
H17	87/88	6.5	7.0	8.0	8.0	10.0	10.0	10.0			b		R		7.0	57.0	66.0	64.0	70.0	
H18	87/88	5.5	9.0	9.0	8.5	10.0	10.0	10.0			b		R		6.0	62.0	70.0	65.0	69.0	
H19	87/88	5.5	9.0	9.0	9.0	10.0	10.0	10.0			b		R		7.0	59.0	66.0	63.0	68.0	
H20	87/88	7.0	9.0	9.0	9.5	10.0	10.0	10.0			b		R		9.0	57.0	66.0	66.0	71.0	
H21	87/88	7.0	9.0	9.0	10.0	10.0	10.0	10.0			b		R		7.0	62.0	77.0	62.0	73.0	
H22	87/88	6.0	7.0	7.0	10.0	10.0	10.0	10.0			b	f	R		6.0	40.0	35.0	71.0	75.0	6.0
H23	87/88	5.5	9.0	8.5	9.0	10.0	10.0	10.0			bB	f	R		6.0	55.0	63.0	67.0	72.0	6.0
H24	87/88	7.0	9.5	9.5	10.0	10.0	10.0	10.0			b	(f)	R		8.0	65.0	70.0	69.0	73.0	
H25	87/88	7.0	8.0	9.5	10.0	10.0	10.0	10.0			b	(f)	R		8.0	69.0	75.0	63.0	70.0	

Cont.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
H26	87/88	7.0	9.0	9.0	8.5	10.0	10.0	10.0			b		R		7.0	66.0	71.0	67.0	71.0	
H27	87/88	7.0	6.0	9.0	10.0	10.0	10.0	10.0			b		R		7.0	56.0	64.0	61.0	70.0	
H28	87/88	7.0	9.0	9.0	10.0	10.0	10.0	10.0			b		R		7.0	59.0	62.0	67.0	69.0	
H29	87/88	7.0	9.0	9.0	10.0	10.0	10.0	10.0			b		R		7.0	52.0	53.0	70.0	72.0	
H30	87/88	7.0	9.0	9.0	10.0	10.0	10.0	10.0			b		R		8.0	56.0	61.0	68.0	75.0	
H31	87/88	7.0	7.0	9.0	10.0	10.0	10.0	10.0			b		R		9.0	48.0	75.0	65.0	74.0	
H32	87/88	6.5	7.0	9.0	10.0	10.0	10.0	10.0			b	(f)	R		9.0	52.0	69.0	63.0	77.0	
H33	87/88	8.0	9.0	9.0	10.0	10.0	10.0	10.0					rR		9.0	51.0	62.0	66.0	72.0	
+H34	87/88		8.0	9.5	10.0	10.0	10.0	10.0			(b)		R		9.0	60.0	76.0	59.0	78.0	
+H35	87/88		9.0	9.5	9.5	10.0	10.0	10.0			b		R		7.0	66.0	72.0	61.0	74.0	
H36	87/88	7.0	8.0	9.0	10.0	10.0	10.0	10.0			b		R		9.0	37.0	71.0	59.0	74.0	
H37	87/88	7.5	9.0	9.0	8.0	10.0	10.0	10.0			b	(f)	R		8.0	60.0	65.0	70.0	72.0	
H38	87/88	6.5	9.0	5.0	6.0	10.0	10.0	10.0			b		R		9.0	23.0	25.0	65.0	72.0	6.0
H39	87/88	5.0	8.0	9.0	9.5	10.0	10.0	10.0			bB	f	R		5.0	53.0	63.0	70.0	73.0	5.0

+: The evaluation of the damage located in and near cut is made on the backside.

Table 3: The results of 1 year's exposure of wood with alkyd paint.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
I 1	87/88	9.0	9.0	7.0	10.0	10.0	10.0	10.0								2.8				
I 2	87/88	9.0	9.0	8.0	10.0	10.0	10.0	10.0								3.5				
I 3	87/88	9.0	9.0	7.0	10.0	10.0	10.0	10.0								2.7				
I 4	87/88	8.0	8.0	8.5	10.0	10.0	10.0	10.0								3.2				
I 5	87/88	8.0	8.0	9.0	10.0	10.0	10.0	10.0								4.2				
I 6	87/88	8.0	8.0	8.5	10.0	10.0	10.0	10.0								3.5				
I 7	87/88	9.0	9.0	8.0	10.0	10.0	10.0	10.0								3.1				
I 8	87/88	9.0	9.0	9.5	10.0	10.0	10.0	10.0								3.4				
I 9	87/88	9.0	9.0	8.0	9.5	10.0	10.0	10.0								3.9				
I10	87/88	9.0	9.0	7.0	10.0	10.0	10.0	10.0								2.9				
I11	87/88	9.0	9.0	8.0	10.0	10.0	10.0	9.5								3.2				
I12	87/88	9.0	9.0	7.0	10.0	10.0	10.0	10.0								3.1				
I13	87/88	8.0	8.0	8.0	10.0	10.0	10.0	9.5								2.3				
I14	87/88	5.5	7.5	7.5	5.0	10.0	10.0	10.0								2.5				
I15	87/88	9.0	9.0	7.0	10.0	10.0	10.0	10.0								2.8				
I16	87/88	5.0	7.0	8.0	5.0	10.0	10.0	10.0								2.6				
I17	87/88	8.0	8.0	8.0	10.0	10.0	10.0	10.0								3.1				
I18	87/88	9.0	9.0	8.5	8.5	10.0	10.0	10.0								3.3				
I19	87/88	9.0	9.0	9.0	8.5	10.0	10.0	10.0								3.4				
I20	87/88	9.0	9.0	9.0	8.0	10.0	10.0	10.0								3.0				
I21	87/88	8.0	8.0	9.5	10.0	10.0	10.0	10.0								2.8				
I22	87/88	9.0	9.0	7.0	10.0	10.0	10.0	10.0								2.9				
I23	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0								4.5				
I24	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0								4.1				
I25	87/88	8.5	8.5	9.0	10.0	10.0	10.0	10.0								4.2				

Cont.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
I26	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0								3.9				
I27	87/88	8.5	8.5	9.0	10.0	10.0	10.0	10.0								4.7				
I28	87/88	9.0	9.0	8.5	10.0	10.0	10.0	10.0								3.1				
I29	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0								4.9				
I30	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0								3.0				
I31	87/88	9.0	9.0	7.5	10.0	10.0	10.0	9.5								3.1				
I32	87/88	8.0	8.0	8.0	10.0	10.0	10.0	10.0								2.3				
I33	87/88	9.0	9.0	7.5	10.0	10.0	10.0	10.0								3.2				
I34	87/88	8.0	8.0	9.0	10.0	10.0	10.0	10.0								3.5				
I35	87/88	9.0	9.0	9.0	9.5	10.0	10.0	10.0								4.3				
I36	87/88	8.5	8.5	8.0	10.0	10.0	10.0	9.5								2.5				
I37	87/88	9.5	9.5	7.0	10.0	10.0	10.0	10.0								3.2				
I38	87/88	9.5	9.5	5.0	10.0	10.0	10.0	10.0								2.6				
I39	87/88	9.0	9.0	7.5	10.0	10.0	10.0	10.0								2.6				

Table 4: The results of 1 year's exposure of wood with acrylate opaque stain.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
K 1	87/88	8.5	8.5	8.0	10.0	10.0	10.0	10.0								3.7				
K 2	87/88	8.5	8.5	9.5	10.0	10.0	10.0	10.0								5.6				
K 3	87/88	8.5	8.5	8.0	10.0	10.0	10.0	10.0								2.5				
K 4	87/88	7.5	7.5	9.5	10.0	10.0	10.0	10.0								3.2				
K 5	87/88	8.0	8.0	9.5	10.0	10.0	10.0	10.0								3.4				
K 6	87/88	7.5	7.5	9.5	10.0	10.0	10.0	10.0								3.2				
K 7	87/88	8.5	8.5	9.5	10.0	10.0	10.0	10.0								3.6				
K 8	87/88	7.5	7.5	9.5	10.0	10.0	10.0	10.0								4.6				
K 9	87/88	8.0	8.0	9.5	10.0	10.0	10.0	10.0								2.9				
K10	87/88	7.5	7.5	9.5	10.0	10.0	10.0	10.0								2.3				
K11	87/88	8.0	8.0	9.5	10.0	10.0	10.0	10.0								2.8				
K12	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0								3.3				
K13	87/88	7.5	7.5	9.0	10.0	10.0	10.0	10.0								2.2				
K14	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0								2.6				
K15	87/88	7.5	7.5	9.5	10.0	10.0	10.0	10.0								2.5				
K16	87/88	7.5	7.5	9.0	9.5	10.0	10.0	10.0								2.2				
K17	87/88	7.5	7.5	9.5	10.0	10.0	10.0	10.0								2.8				
K18	87/88	8.0	8.0	9.5	10.0	10.0	10.0	10.0								3.5				
K19	87/88	9.0	9.0	9.5	10.0	10.0	10.0	10.0								3.1				
K20	87/88	8.0	8.0	9.5	10.0	10.0	10.0	10.0								2.9				
K21	87/88	7.5	7.5	9.5	10.0	10.0	10.0	10.0								3.3				
K22	87/88	8.5	8.5	8.0	10.0	10.0	10.0	10.0								2.7				
K23	87/88	9.0	9.0	9.5	10.0	10.0	10.0	10.0								5.4				
K24	87/88	8.0	8.0	9.0	10.0	10.0	10.0	10.0								4.3				
K25	87/88	7.5	7.5	9.0	10.0	10.0	10.0	10.0								3.1				

Cont.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
K26	87/88	8.5	8.5	9.5	10.0	10.0	10.0	10.0								5.0				
K27	87/88	8.5	8.5	9.0	10.0	10.0	10.0	10.0								3.1				
K28	87/88	8.5	8.5	9.5	10.0	10.0	10.0	10.0								2.9				
K29	87/88	9.0	9.0	9.5	10.0	10.0	10.0	10.0								3.4				
K30	87/88	8.5	8.5	9.5	10.0	10.0	10.0	10.0								2.8				
K31	87/88	8.5	8.5	9.5	10.0	10.0	10.0	10.0								3.0				
K32	87/88	7.5	7.5	9.0	10.0	10.0	10.0	10.0								2.1				
K33	87/88	9.0	9.0	9.0	10.0	10.0	10.0	10.0								3.7				
K34	87/88	7.5	7.5	9.5	10.0	10.0	10.0	10.0								3.0				
K35	87/88	9.0	9.0	9.5	10.0	10.0	10.0	10.0								3.6				
K36	87/88	8.5	8.5	9.0	10.0	10.0	10.0	10.0								2.6				
K37	87/88	9.5	9.5	9.0	10.0	10.0	10.0	10.0								3.2				
K38	87/88	9.5	9.5	5.0	10.0	10.0	10.0	10.0								2.9				
K39	87/88	8.5	8.5	7.5	10.0	10.0	10.0	10.0								2.3				

Table 5: The results of 2 year's exposure of coil coated steel with alkyd melamine coating.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
G 1	87/89	9.0	9.0	6.0	10.0	10.0	10.0	10.0							7.0	9.7	6.2			
G 2	87/89	8.0	8.5	5.0	9.0	10.0	10.0	10.0			(b)		(r)		8.0	4.3	3.5			10.0
G 3	87/89	8.0	8.0	9.0	10.0	10.0	10.0	10.0							7.0	21.0	31.0			10.0
G 4	87/89	8.0	7.5	6.5	7.0	10.0	10.0	10.0			(b)				7.0	13.0	12.0			
G 5	87/89	8.5	9.0	6.5	9.0	10.0	10.0	10.0			(b)		(r)		8.0	12.0	11.0			
G 6	87/89	8.5	9.5	6.5	10.0	10.0	10.0	10.0			(b)				8.0	12.0	11.0			
G 7	87/89	9.0	9.5	6.0	9.0	10.0	10.0	10.0			(b)		(r)		7.0	7.6	3.8			
G 8	87/89	7.5	8.0	7.0	9.5	10.0	10.0	10.0			(b)	f	(r)		7.0	17.0	18.0			
G 9	87/89	8.0	8.5	6.5	8.0	10.0	10.0	10.0			(b)				7.0	8.1	6.8			
G10	87/89	7.5	8.0	6.5	9.5	10.0	10.0	10.0					r		7.0	24.0	28.0			
G11	87/89	8.5	8.5	6.5	9.0	10.0	10.0	10.0			(b)				7.0	6.4	4.2			
G12	87/89	9.0	9.5	6.5	8.0	10.0	10.0	10.0				f			7.0	9.4	6.1			
G13	87/89	7.0	6.5	9.0	10.0	10.0	10.0	10.0				f	r		8.0	12.0	21.0			
G14	87/89	8.5	9.0	6.5	9.5	10.0	10.0	10.0			(b)	(f)			8.0	12.0	14.0			
G15	87/89	7.0	8.0	9.0	10.0	10.0	10.0	10.0			(b)	(f)	(r)		7.0	17.0	21.0			10.0
G16	87/89	8.0	6.0	6.0	7.0	10.0	10.0	10.0			(b)	(f)			8.0	9.8	11.0			10.0
G17	87/89	8.0	8.0	6.0	7.0	10.0	10.0	10.0			(b)	(f)	(r)		7.0	7.2	4.3			
G18	87/89	7.0	7.0	7.0	8.5	10.0	10.0	10.0			b		r		7.0	17.0	15.0			
G19	87/89	8.0	8.0	6.5	9.0	10.0	10.0	10.0			b		(r)		7.0	8.9	6.2			
G20	87/89	9.0	9.0	6.0	8.0	10.0	10.0	10.0				f			7.0	6.6	4.0			
G21	87/89	8.0	9.5	9.0	10.0	10.0	10.0	10.0			(b)	f			7.0	22.0	23.0			
G22	87/89	6.0	10.0	5.5	10.0	9.5	10.0	10.0			(b)	f	r		7.0	2.0	2.3			10.0
G23	87/89	8.0	10.0	6.0	9.0	10.0	10.0	10.0			b		r		6.0	5.7	4.6			10.0
G24	87/89	9.0	9.5	7.0	10.0	10.0	10.0	10.0			(b)	f			8.0	15.0	13.0			
G25	87/89	8.0	8.0	9.0	10.0	10.0	10.0	10.0				f			8.0	27.0	30.0			

Cont.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
G26	87/89	8.0	9.0	9.0	9.0	10.0	10.0	10.0			(b)		(r)		8.0	21.0	20.0			
G27	87/89	8.0	8.0	6.0	9.5	10.0	10.0	10.0			b				8.0	5.7	4.0			
G28	87/89	9.0	9.5	6.0	10.0	10.0	10.0	10.0			b		(r)		8.0	7.1	4.8			
G29	87/89	8.0	9.5	6.0	10.0	10.0	10.0	10.0			(b)		r		7.0	2.4	2.4			10.0
G30	87/89	9.0	9.5	6.0	10.0	10.0	10.0	10.0			b				8.0	4.9	3.4			
G31	87/89	8.0	9.5	9.0	10.0	10.0	10.0	10.0							8.0	19.0	19.0			
G32	87/89	7.5	8.0	9.0	10.0	10.0	10.0	10.0			b		r		8.0	15.0	17.0			
G33	87/89	9.0	9.5	6.5	10.0	10.0	10.0	10.0				(f)			9.0	6.7	8.2			
xG34	87/89		7.5	9.0	10.0	10.0	10.0	10.0					(r)					27.0	35.0	
xG35	87/89		8.5	9.0	10.0	10.0	10.0	10.0										36.0	37.0	
G36	87/89	8.0	9.5	7.0	10.0	10.0	10.0	10.0			b	(f)			9.0	15.0	19.0			
G37	87/89	9.0	10.0	6.5	9.0	10.0	10.0	10.0			(b)	f	(r)		7.0	5.4	5.7			
G38	87/89	8.0	8.5	5.0	7.0	10.0	10.0	10.0				f	r		8.0	1.7	3.7			10.0
G39	87/89	8.0	8.0	6.0	8.0	10.0	10.0	10.0				f	r		7.0	8.5	8.5			10.0

x: The evaluation has been carried out on the back side for all the parameters.

Table 6: The results of 2 year's exposure of steel panels with silicon alkyd paint.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
H 1	87/89	6.0	7.5	8.5	8.0	10.0	10.0	10.0			b		R		5.0	46.0	47.0	64.0	69.0	5.5
H 2	87/89	7.0	8.0	7.0	7.0	10.0	10.0	10.0			bB		R		6.0	21.0	16.0	67.0	70.0	
H 3	87/89	4.5	6.0	9.5	9.5	10.0	10.0	10.0			B		R		3.0	42.0	65.0	63.0	69.0	5.5
H 4	87/89	5.5	8.0	8.0	6.0	10.0	10.0	10.0			B		R		5.0	47.0	46.0	59.0	67.0	5.5
H 5	87/89	7.0	8.0	8.0	7.5	10.0	10.0	10.0			bB		R		7.0	48.0	35.0	64.0	67.0	
H 6	87/89	7.0	9.0	8.0	10.0	10.0	10.0	10.0			bB		R		6.0	47.0	45.0	61.0	69.0	5.5
H 7	87/89	6.0	7.5	8.0	7.5	10.0	10.0	10.0			B		R		6.0	44.0	38.0	58.0	65.0	5.0
H 8	87/89	7.0	6.0	9.0	7.5	10.0	10.0	10.0			bB		R		7.0	54.0	56.0	61.0	69.0	
H 9	87/89	6.0	6.0	9.0	7.5	10.0	10.0	10.0			bB		R		7.0	45.0	41.0	58.0	69.0	
H10	87/89	6.0	7.0	8.0	10.0	10.0	10.0	10.0			B		R		6.0	48.0	58.0	56.0	60.0	5.5
H11	87/89	6.5	7.0	9.0	9.0	10.0	10.0	10.0			bB		R		6.0	45.0	40.0	57.0	68.0	
H12	87/89	7.5	8.0	7.0	7.5	10.0	10.0	10.0			bB		R		7.0	32.0	23.0	63.0	68.0	
H13	87/89	6.5	5.5	8.5	10.0	10.0	10.0	10.0			b	(f)	R		7.0	24.0	37.0	54.0	68.0	
H14	87/89	7.0	7.5	8.5	9.0	10.0	10.0	10.0			b		R		7.0	35.0	37.0	55.0	63.0	
H15	87/89	5.0	6.0	8.5	10.0	10.0	10.0	10.0			B		R		5.0	46.0	49.0	59.0	69.0	5.0
H16	87/89	5.0	8.0	7.5	6.0	10.0	10.0	10.0			B		R		7.0	29.0	22.0	51.0	58.0	
H17	87/89	6.5	5.0	8.5	7.5	10.0	10.0	10.0			b		R		6.0	43.0	34.0	51.0	63.0	
H18	87/89	5.5	6.0	8.5	7.5	10.0	10.0	10.0			B		R		6.0	46.0	48.0	54.0	63.0	
H19	87/89	5.5	6.0	8.5	8.0	10.0	10.0	10.0			B		R		6.0	42.0	39.0	49.0	59.0	
H20	87/89	7.0	8.0	7.5	7.5	10.0	10.0	10.0			bB		R		6.0	38.0	32.0	56.0	65.0	
H21	87/89	7.0	8.5	9.0	10.0	10.0	10.0	10.0			bB		R		7.0	53.0	53.0	58.0	71.0	
H22	87/89	6.0	9.0	4.0	10.0	10.0	10.0	10.0			B		R		6.0	12.0	8 4	64.0	67.0	5.5
H23	87/89	5.5	8.5	6.0	8.0	10.0	10.0	10.0			B		R		5.0	24.0	21.0	57.0	60.0	5.5
H24	87/89	7.0	9.0	8.0	10.0	10.0	10.0	10.0			b		R		7.0	49.0	45.0	64.0	73.0	
H25	87/89	7.0	8.0	9.0	10.0	10.0	10.0	10.0			b	f	R		6.0	59.0	60.0	58.0	69.0	

Cont.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
H26	87/89	6.5	8.0	9.0	7.5	10.0	10.0	10.0			B		R		5.0	57.0	58.0	62.0	66.0	
H27	87/89	7.0	8.5	8.0	9.5	10.0	10.0	10.0			bB		R		7.0	41.0	37.0	61.0	65.0	
H28	87/89	7.0	9.0	7.5	10.0	10.0	10.0	10.0			b		R		7.0	36.0	27.0	64.0	67.0	
H29	87/89	6.5	9.0	6.0	9.5	10.0	10.0	10.0			B		R		5.0	13.0	10.0	62.0	66.0	
H30	87/89	7.0	8.0	8.0	9.5	10.0	10.0	10.0			b		R		7.0	37.0	27.0	63.0	68.0	
H31	87/89	7.0	8.5	8.0	10.0	10.0	10.0	10.0			bB		R		7.0	50.0	49.0	65.0	71.0	
H32	87/89	6.5	6.0	8.0	10.0	10.0	10.0	10.0			b	(f)	R		7.0	37.0	43.0	61.0	71.0	
H33	87/89	8.5	9.0	7.0	10.0	10.0	10.0	10.0			(b)		r		9.0	31.0	23.0	56.0	62.0	
+H34	87/89		9.5	9.5	10.0	10.0	10.0	10.0			b		R		8.0	52.0	67.0	63.0	74.0	
+H35	87/89		9.5	8.0	10.0	10.0	10.0	10.0			bB	(f)	R		5.0	40.0	37.0	65.0	68.0	
H36	87/89	7.0	7.5	8.0	10.0	10.0	10.0	10.0			b	(f)	R		6.0	31.0	46.0	62.0	69.0	
H37	87/89	7.0	9.0	6.0	7.0	10.0	10.0	10.0			bB		R		6.0	24.0	15.0	68.0	73.0	
H38	87/89	6.5	7.0	3.0	5.0	10.0	10.0	10.0			bB		R		6.0	5.0	7.3	56.0	65.0	5.0
H39	87/89	5.0	6.0	8.5	7.0	10.0	10.0	10.0			B		R		4.0	25.0	35.0	62.0	68.0	5.0

+: The evaluation of the damage located in and near the cut is made on the back side.

Table 7: The results of 2 year's exposure of wood with alkyd paint.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
I 1	87/89	8.0	8.0	6.0	10.0	10.0	10.0	10.0								2.6				
I 2	87/89	9.0	9.0	7.5	8.5	10.0	10.0	10.0								2.0				
I 3	87/89	8.0	8.0	7.0	10.0	10.0	10.0	10.0								2.2				
I 4	87/89	9.5	9.5	7.0	9.5	10.0	10.0	10.0								2.9				
I 5	87/89	9.0	9.0	6.5	9.0	10.0	10.0	10.0								2.5				
I 6	87/89	9.5	9.5	8.0	10.0	10.0	10.0	10.0								2.8				
I 7	87/89	8.0	8.0	6.0	9.0	10.0	10.0	10.0								2.2				
I 8	87/89	9.5	9.5	6.0	10.0	10.0	10.0	10.0								2.5				
I 9	87/89	9.0	9.0	6.0	9.0	10.0	10.0	10.0								2.9				
I10	87/89	9.0	9.0	7.0	10.0	10.0	10.0	9.5								2.1				
I11	87/89	9.0	9.0	6.0	9.0	10.0	10.0	10.0								2.5				
I12	87/89	9.0	9.0	6.0	8.5	10.0	10.0	10.0								2.7				
I13	87/89	6.0	6.0	7.5	10.0	10.0	10.0	10.0								2.0				
I14	87/89	5.0	9.0	6.5	6.0	10.0	9.5	10.0								2.1				
I15	87/89	9.5	9.5	7.0	10.0	10.0	10.0	10.0								2.6				
I16	87/89	3.0	9.0	8.0	3.0	10.0	6.0	10.0								1.8				
I17	87/89	8.0	9.0	6.5	8.0	10.0	10.0	10.0								2.7				
I18	87/89	5.0	9.0	8.5	6.0	10.0	8.0	10.0								2.8				
I19	87/89	6.0	9.0	7.0	6.0	10.0	9.5	10.0								3.0				
I20	87/89	5.0	9.0	7.0	6.0	10.0	9.5	10.0								2.8				
I21	87/89	9.5	9.5	8.0	10.0	10.0	10.0	10.0								2.9				
I22	87/89	9.5	9.5	6.0	10.0	10.0	10.0	10.0								2.6				
I23	87/89	9.0	9.0	7.0	9.0	10.0	10.0	10.0								2.9				
I24	87/89	9.5	9.5	8.0	10.0	10.0	10.0	10.0								3.9				
I25	87/89	9.0	9.0	7.5	10.0	10.0	10.0	10.0								3.4				

Cont.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
I26	87/89	8.0	8.0	6.5	9.5	10.0	10.0	10.0								2.9				
I27	87/89	9.0	9.0	8.0	10.0	10.0	10.0	9.5								3.0				
I28	87/89	9.5	9.5	7.0	9.5	10.0	9.5	10.0								2.9				
I29	87/89	9.5	9.5	7.0	10.0	10.0	10.0	10.0								3.2				
I30	87/89	9.5	9.5	7.0	9.5	10.0	10.0	10.0								2.9				
I31	87/89	9.5	9.5	7.0	10.0	10.0	10.0	10.0								2.6				
I32	87/89	6.0	6.0	7.0	10.0	10.0	10.0	10.0								2.2				
I33	87/89	10.0	10.0	6.0	10.0	10.0	10.0	10.0								2.8				
I34	87/89	7.0	7.0	9.0	10.0	10.0	10.0	10.0								3.0				
I35	87/89	8.0	8.0	7.5	9.0	10.0	10.0	10.0								3.0				
I36	87/89	6.0	6.0	6.0	7.5	10.0	9.0	10.0								2.3				
I37	87/89	10.0	10.0	6.0	9.5	10.0	10.0	10.0								2.6				
I38	87/89	9.0	9.0	5.0	8.5	10.0	10.0	10.0								2.4				
I39	87/89	9.0	9.0	6.0	8.5	10.0	10.0	10.0								2.4				

Table 8: The results of 2 year's exposure of wood with acrylate opaque stain.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
K 1	87/89	8.0	8.0	5.0	10.0	10.0	10.0	10.0								2.5				
K 2	87/89	8.0	8.0	5.0	10.0	10.0	10.0	10.0								2.6				
K 3	87/89	8.0	8.0	5.0	10.0	10.0	10.0	10.0								2.6				
K 4	87/89	9.0	9.0	7.0	10.0	10.0	10.0	10.0								3.0				
K 5	87/89	9.0	9.0	7.0	10.0	10.0	10.0	10.0								3.5				
K 6	87/89	9.0	9.0	7.0	10.0	10.0	10.0	10.0								3.5				
K 7	87/89	9.0	9.0	6.0	10.0	10.0	10.0	10.0								2.8				
K 8	87/89	8.0	8.0	8.0	10.0	10.0	10.0	10.0								3.2				
K 9	87/89	8.0	8.0	6.0	10.0	10.0	10.0	10.0								2.9				
K10	87/89	8.0	8.0	6.0	10.0	10.0	10.0	9.5								2.8				
K11	87/89	8.0	8.0	7.0	10.0	10.0	10.0	10.0								2.8				
K12	87/89	10.0	10.0	5.0	9.5	10.0	10.0	10.0								3.2				
K13	87/89	6.0	6.0	7.0	10.0	10.0	10.0	10.0								1.9				
K14	87/89	9.0	9.0	6.0	10.0	9.5	10.0	9.5								2.4				
K15	87/89	8.0	8.0	6.0	10.0	10.0	10.0	10.0								2.2				
K16	87/89	7.0	7.0	7.0	9.5	10.0	10.0	9.5								2.7				
K17	87/89	7.0	7.0	7.0	10.0	10.0	10.0	9.5								2.8				
K18	87/89	8.0	8.0	7.0	9.5	10.0	10.0	10.0								2.8				
K19	87/89	8.0	8.0	6.0	9.5	10.0	10.0	10.0								2.5				
K20	87/89	8.0	8.0	7.0	10.0	10.0	10.0	10.0								2.6				
K21	87/89	8.0	8.0	7.0	10.0	10.0	10.0	10.0								3.4				
K22	87/89	9.0	9.0	6.0	10.0	10.0	10.0	10.0								2.4				
K23	87/89	10.0	10.0	7.0	10.0	10.0	10.0	10.0								2.9				
K24	87/89	9.0	9.0	7.0	10.0	10.0	10.0	10.0								3.6				
K25	87/89	8.0	8.0	7.0	10.0	10.0	10.0	10.0								3.2				

Cont.

Site	Year	Gen. appearance	Dirt	Chalking	Fungus	Flaking	Cracking	Checking			Damage located in and near cut					Gloss W = washed U = unwashed				Adhesion
											Type of damage			Damage area	Damage (ASTM)	Front		Back		
											B/b	F/f	Rust			U	W	U	W	
K26	87/89	9.0	9.0	6.0	10.0	10.0	10.0	10.0								3.1				
K27	87/89	8.0	8.0	6.0	10.0	10.0	10.0	10.0								2.7				
K28	87/89	9.0	9.0	7.0	10.0	10.0	10.0	10.0								3.0				
K29	87/89	9.0	9.0	7.0	9.0	10.0	10.0	10.0								3.1				
K30	87/89	9.0	9.0	7.0	10.0	10.0	10.0	10.0								3.2				
K31	87/89	9.0	9.0	7.0	10.0	10.0	10.0	10.0								2.7				
K32	87/89	6.0	6.0	7.0	10.0	10.0	10.0	10.0								2.1				
K33	87/89	9.0	9.0	5.0	10.0	10.0	10.0	10.0								3.0				
K34	87/89	7.0	7.0	8.0	10.0	10.0	10.0	10.0								2.4				
K35	87/89	9.0	9.0	6.0	9.5	10.0	10.0	10.0								3.6				
K36	87/89	8.0	8.0	6.0	10.0	10.0	10.0	10.0								2.3				
K37	87/89	10.0	10.0	5.0	10.0	10.0	10.0	10.0								2.6				
K38	87/89	10.0	10.0	4.0	10.0	10.0	10.0	10.0								2.2				
K39	87/89	8.0	8.0	6.0	9.0	10.0	10.0	9.0								2.4				

ANNEX 3

Summary table of regression coefficients for multiple linear regressions of rating numbers of decay (tables A) and yearly differences (tables B) on environmental variables. (Standard errors of the coefficients are given in parenthesis.)

A: GENERAL APPEARANCE (regression on rating number).

Paint system:	G		H		I		K	
Exposure time:	1 year	2 years	1 year	2 years	1 year	2 years	1 year	2 years
CONSTANT	11.32(1.32)**	10.27(1.72)**	8.91(1.40)**	9.00(1.64)**	8.94(0.95)**	14.64(3.74)**	8.59(1.18)**	11.70(1.74)**
TOW x 10^{-4} (h)	- 0.35(0.96)	- 0.10(1.18)	- 1.87(1.01)+	- 2.31(1.12)+	0.32(0.68)	- 5.29(2.64)*	- 0.49(0.93)	- 1.99(1.23)
NO_2 x 10^{-2} ($\mu g/m^3$)	- 1.53(0.87)+	2.12(1.39)	1.03(0.91)	1.07(1.33)	- 1.66(0.61)*	0.45(2.59)	- 2.04(0.84)*	- 2.93(1.20)*
SO_2 x 10^{-2} ($\mu g/m^3$)	- 0.13(0.93)	0.68(1.49)	- 2.53(0.09)*	- 3.75(1.43)*	0.71(0.66)	- 1.79(3.21)	0.77(0.90)	0.09(1.49)
PREC x 10^{-4} (mm)	- 8.69(3.45)*	- 7.03(6.67)	- 7.61(3.63)*	- 9.81(6.35)	- 2.30(2.45)	- 0.67(15.20)	- 0.57(3.34)	8.41(7.07)
TEMP (^0C)	0.01(0.04)	0.01(0.07)	- 0.02(0.04)	0.07(0.07)	0.04(0.03)	- 0.09(0.14)	0.03(0.04)	- 0.02(0.07)
pH	- 0.34(0.26)	- 0.18(0.34)	- 0.12(0.28)	- 0.36(0.33)	- 0.03(0.19)	- 0.76(0.72)	0.04(0.26)	- 0.41(0.34)
SO_2/NO_2 RATIO	- 0.11(0.06)+	- 0.47(0.45)	0.04(0.07)	0.47(0.43)	- 0.05(0.05)	0.32(0.94)	- 0.13(0.06)+	- 0.17(0.44)
SIGNIFICANCE LEVEL OF REGRESSION	0.04	0.40	0.02	0.03	0.15	0.31	0.27	<0.01
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.47	0.27	0.51	0.49	0.37	0.28	0.31	0.54
NUMBER OF VALID OBS.	29	29	29	29	29	31	29	31

Symbols:
** Coefficient is significantly nonzero on univariate level less than 0.01.
* Coefficient is significantly nonzero on univariate level between 0.05 and 0.01.
+ Coefficient is significantly nonzero on univariate level between 0.1 and 0.25.

Interpretation of coefficients:
A coefficient with positive sign - with higher level of environmental variable, higher rating number, e.g. bettering.

A: DIRT (regression on rating number).

Paint system:	G		H		I		K	
Exposure time:	1 year	2 years	1 year	2 years	1 year	2 years	1 year	2 years
CONSTANT	9.54(1.55)**	10.48(2.13)**	9.70(2.00)**	12.03(2.80)**	8.94(0.95)**	14.53(3.57)**	8.59(1.29)**	11.70(1.74)**
TOW x 10^{-4} (h)	1.15(1.12)	- 1.15(1.50)	0.28(1.45)	- 3.47(1.98)+	0.32(0.68)	- 4.65(2.52)+	- 0.49(0.93)	- 1.99(1.23)
NO_2 x 10^{-2} ($\mu g/m^3$)	1.54(1.01)	- 1.35(1.47)	- 1.97(1.31)	0.17(1.94)	- 1.66(0.62)*	0.42(2.47)	- 2.04(0.84)*	- 2.93(1.20)*
SO_2 x 10^{-2} ($\mu g/m^3$)	0.08(1.08)	- 1.44(1.82)	- 0.47(1.40)	- 2.49(2.40)	0.71(0.66)	- 1.89(3.06)	0.77(0.90)	0.09(1.49)
PREC x 10^{-4} (mm)	0.06(4.03)	- 0.15(8.65)	- 0.41(5.20)	-15.42(11.38)	- 2.30(2.46)	- 0.67(14.50)	- 0.57(3.30)	8.41(7.07)
TEMP (^0C)	- 0.05(0.05)	- 0.01(0.08)	- 0.01(0.06)	- 0.17(0.11)	0.04(0.30)	- 0.08(0.14)	0.03(0.04)	- 0.02(0.07)
pH	- 0.11(0.31)	- 0.22(0.41)	- 0.07(0.40)	- 0.04(0.55)	- 0.03(0.19)	- 0.79(0.70)	0.04(0.26)	- 0.41(0.34)
SO_2/NO_2 RATIO	- 0.14(0.08)+	0.46(0.53)	- 0.24(0.10)*	0.21(0.70)	- 0.05(0.04)	0.32(0.89)	- 0.13(0.06)+	- 0.17(0.44)
SIGNIFICANCE LEVEL OF REGRESSION	0.07	0.17	0.03	0.04	0.15	0.33	0.27	<0.01
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.43	0.33	0.48	0.44	0.37	0.27	0.31	0.54
NUMBER OF VALID OBS.	29	31	29	31	29	31	29	31

Symbols:
** Coefficient is significantly nonzero on univariate level less than 0.01.
* Coefficient is significantly nonzero on univariate level between 0.05 and 0.01.
+ Coefficient is significantly nonzero on univariate level between 0.1 and 0.25.

Interpretation of coefficients:
A coefficient with positive sign - with higher level of environmental variable, higher rating number, e.g. bettering.

A: CHALKING (regression on rating number).

Paint system:	G		H		I		K	
Exposure time:	1 year	2 years	1 year	2 years	1 year	2 years	1 year	2 years
CONSTANT	8.47(1.13)**	5.04(3.12)	9.44(1.14)**	8.68(1.94)**	11.89(0.91)**	5.18(1.33)**	10.04(0.88)**	5.32(1.58)**
SUNSHINE x 10^{-4} (h)	2.72(1.85)	0.38(3.70)	- 0.19(1.87)	- 7.20(2.31)**	- 5.12(1.50)**	- 2.47(1.58)	- 6.73(1.44)**	- 3.65(1.87)+
NO_2 x 10^{-2} ($\mu g/m^3$)	- 0.44(0.78)	0.34(2.27)	- 0.45(0.79)	1.04(1.42)	0.44(0.63)	1.47(0.97)	0.06(0.60)	2.03(1.15)+
SO_2 x 10^{-2} ($\mu g/m^3$)	0.77(0.90)	2.06(2.69)	- 0.37(0.91)	0.75(1.68)	- 0.67(0.73)	1.15(1.15)	- 1.71(0.71)*	- 0.72(1.37)
PREC x 10^{-4} (mm)	- 0.55(2.53)	- 2.32(1.44)	- 5.08(2.56)+	-28.95(9.03)**	- 0.34(2.06)	0.86(6.17)	- 0.67(1.98)	5.28(7.32)
TEMP (^0C)	- 0.02(0.04)	- 0.20(0.14)	- 0.02(0.04)	- 0.07(0.09)	- 0.08(0.03)*	- 0.18(0.06)**	- 0.11(2.80)	- 0.06(0.07)
pH	0.10(0.22)	1.18(0.70)	0.08(0.22)	0.65(0.44)	- 0.24(0.18)	0.86(0.30)*	0.15(0.17)	0.46(0.36)
SO_2/NO_2 RATIO	- 0.21(0.28)	- 0.81(0.85)	- 0.03(0.28)	- 0.45(0.53)	- 0.97(0.22)**	- 0.95(0.36)*	0.01(0.22)	- 0.68(0.43)
SIGNIFICANCE LEVEL OF REGRESSION	0.84	0.27	0.47	<0.01	<0.01	<0.01	<0.01	<0.01
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.19	0.39	0.33	0.77	0.89	0.77	0.81	0.70
NUMBER OF VALID OBS.	22	23	22	23	22	23	22	23

Symbols:

** Coefficient is significantly nonzero on univariate level less than 0.01.

* Coefficient is significantly nonzero on univariate level between 0.05 and 0.01.

+ Coefficient is significantly nonzero on univariate level between 0.1 and 0.25.

Interpretation of coefficients:

A coefficient with positive sign - with higher level of environmental variable, higher rating number, e.g. bettering.

A: FUNGUS (regression on rating number).

Paint system:	G		H		I		K	
Exposure time:	1 year	2 years	1 year	2 years	1 year	2 years	1 year	2 years
CONSTANT	9.89(2.08)**	12.13(2.21)**	12.02(3.23)**	11.51(3.18)**	11.14(2.00)**	19.75(3.85)**		10.68(0.42)**
TOW x 10^{-4} (h)	- 0.35(1.31)	- 3.78(1.61)*	- 2.33(2.04)	- 3.77(2.31)	- 1.14(1.26)	- 8.88(2.82)**	CONSTANT	- 0.54(0.31)+
NO_2 x 10^{-2} ($\mu g/m^3$)	1.16(1.11)	- 0.48(1.45)	2.00(1.72)	0.87(2.09)	1.22(1.06)	- 0.87(2.54)		0.18(0.28)
SO_2 x 10^{-2} ($\mu g/m^3$)	- 3.08(1.79)	0.24(1.72)	- 5.35(2.79)+	0.04(2.48)	- 1.01(1.72)	0.73(3.01)	VALUES	- 0.20(0.33)
PREC x 10^{-4} (mm)	- 0.64(3.90)	-30.04(9.31)**	- 4.88(6.06)	-42.69(13.39)**	1.06(3.75)	-37.26(16.27)*		- 1.53(1.79)
TEMP (^0C)	0.05(0.05)	- 0.17(0.09)+	0.04(0.07)	- 0.17(0.12)	0.02(0.04)	- 0.24(0.15)	OF	- 0.01(0.02)
pH	- 0.12(0.34)	0.31(0.40)	- 0.43(0.52)	0.39(0.57)	- 0.28(0.32)	- 0.79(0.70)		- 0.12(0.08)
TOTAL NITROGEN	0.18(0.24)	0.48(0.16)**	0.61(0.37)	0.54(0.23)*	- 0.21(0.23)	0.66(0.27)*	FUNGUS	0.03(0.03)
SO_2/NO_2 RATIO	0.06(0.44)	- 0.20(0.51)	- 0.54(0.68)	- 0.40(0.73)	0.31(0.42)	- 0.35(0.88)		0.07(0.10)
SIGNIFICANCE LEVEL OF REGRESSION	0.58	0.07	0.18	0.08	0.49	0.07		0.45
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.30	0.46	0.46	0.44	0.32	0.46		0.28
NUMBER OF VALID OBS.	25	30	25	30	25	30		30

Symbols:
** Coefficient is significantly nonzero on univariate level less than 0.01.
* Coefficient is significantly nonzero on univariate level between 0.05 and 0.01.
+ Coefficient is significantly nonzero on univariate level between 0.1 and 0.25.

Interpretation of coefficients:
A coefficient with positive sign - with higher level of environmental variable, higher rating number, e.g. bettering.

A: CUT DAMAGE (regression on rating number).

Paint system:	G		H		I		K	
Exposure time:	1 year	2 years	1 year	2 years	1 year	2 years	1 year	2 years
CONSTANT	8.67(1.22)**	9.78(1.28)**	8.10(2.67)**	5.40(1.70)**				
TOW x 10^{-4} (h)	- 2.46(0.88)**	- 1.76(0.87)+	- 3.32(1.93)	- 1.96(1.20)				
NO_2 x 10^{-2} ($\mu g/m^3$)	- 0.35(0.80)	- 0.69(1.04)	1.52(1.74)	4.03(1.18)**				
SO_2 x 10^{-2} ($\mu g/m^3$)	- 0.87(0.85)*	- 0.48(1.11)	- 2.69(1.86)	- 7.16(1.46)**				
PREC x 10^{-4} (mm)	- 4.91(3.17)	-11.67(4.96)*	- 3.36(6.92)	- 7.40(6.91)				
TEMP (^0C)	0.04(0.04)	0.09(0.05)	0.09(0.08)	0.17(0.06)*				
pH	0.34(0.24)	- 0.30(0.26)	0.04(0.53)	- 0.06(0.33)				
SO_2/NO_2 RATIO	0.03(0.06)	- 0.13(0.33)	- 0.05(0.13)	1.21(0.43)**				
SIGNIFICANCE LEVEL OF REGRESSION	0.03	0.07	0.20	<0.01				
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.48	0.43	0.34	0.64				
NUMBER OF VALID OBS.	29	29	29	31				

Symbols:
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Interpretation of coefficients:
A coefficient with positive sign - with higher level of environmental variable, higher rating number, e.g. bettering.

B: GENERAL APPEARANCE, regression on Δ = $\frac{10 - \text{rating number after 1 year}}{(1 - \text{year exposure data})}$.

\rating number after one year - rating number after two years (2 years of exposure).

PAINT SYSTEM:	G	H	I	K
CONSTANT	- 0.88 (0.80)	- 0.30 (0.78)	- 2.55 (1.25)*	- 0.98 (0.68)
EXP.2 YEAR (yes=1, no=0)	1.17 (0.16)**	3.18 (0.16)**	0.46 (0.25)+	1.46 (0.14)**
TOW x 10^{-4} (h)	- 0.10 (0.63)	0.83 (0.61)	1.82 (0.98)+	0.62 (0.54)
NO_2 x 10^{-2} ($\mu g/m^3$)	0.87 (0.52)	0.72 (0.51)	0.26 (0.77)	1.10 (0.04)*
SO_2 x 10^{-2} ($\mu g/m^3$)	2.04 (5.08)	0.88 (0.49)+	0.51 (0.79)	0.01 (4.30)
PREC x 10^{-4} (mm)	6.24 (2.65)*	4.62 (2.59)+	2.42 (4.18)	0.11 (2.32)
TEMP (^0C)	- 0.03 (0.16)	0.02 (0.03)	- 0.01 (0.04)	- 0.02 (0.02)
pH	0.17 (0.16)	- 0.08 (0.15)	0.51 (0.25)*	0.15 (0.14)
SO_2/NO_2 RATIO	0.13 (0.05)**	0.03 (0.05)	- 0.02 (0.08)	0.08 (0.05)+
SIGNIFICANCE LEVEL OF REGRESSION	<0.01	<0.01	0.11	<0.01
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.66	0.92	0.21	0.74
NUMBER OF VALID OBS.	58	58	60	60

Symbols:

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* Coefficient is significantly nonzero on univariate level between 0.05 and 0.01.

+ Coefficient is significantly nonzero on univariate level between 0.1 and 0.25.

Interpretation of coefficients:

A higher coefficient with positive sign - with higher value of environmental variable, higher difference between the rating numer of the preceeding and the next year, e.g. worsening.

B: DIRT, regression on Δ = /10 - rating number after 1 year (1 - year exposure data).
\rating number after one year -
rating number after two years (2 years of exposure).

PAINT SYSTEM:	G	H	I	K
CONSTANT	- 0.74 (0.85)	- 1.73 (1.31)	- 2.55 (1.25)*	- 0.98 (0.70)
EXP.2 YEAR (yes=1, no=0)	1.35 (0.16)**	0.99 (0.26)**	0.48 (0.25)+	1.46 (0.13)**
TOW x 10^{-4} (h)	0.30 (0.66)	1.93 (1.02)+	1.61 (0.97)	0.62 (0.54)
NO_2 x 10^{-2} ($\mu g/m^3$)	0.79 (0.52)	0.58 (0.80)	0.24 (0.77)	1.10 (0.42)*
SO_2 x 10^{-2} ($\mu g/m^3$)	- 0.37 (0.53)	0.49 (0.82)+	0.52 (0.78)	- 0.01 (0.43)
PREC x 10^{-4} (mm)	0.22 (2.83)	2.42 (4.34)+	2.10 (4.17)	0.11 (2.32)
TEMP (^0C)	0.01 (0.03)	- 0.02 (0.04)	- 0.01 (0.04)	- 0.02 (0.02)
pH	0.15 (0.17)	0.27 (0.26)	0.51 (0.25)*	0.15 (0.14)
SO_2/NO_2 RATIO	0.16 (0.06)**	0.22 (0.09)**	- 0.03 (0.08)	0.08 (0.05)+
SIGNIFICANCE LEVEL OF REGRESSION	<0.01	<0.01	0.11	<0.01
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.64	0.44	0.21	0.74
NUMBER OF VALID OBS.	60	60	60	60

Symbols:
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+ Coefficient is significantly nonzero on univariate level between 0.1 and 0.25.

Interpretation of coefficients:
A coefficient with positive sign - with higher value of environmental variable, higher difference between the rating numer of the preceeding and the next year, e.g. worsening.

B: CHALKING, regression on Δ = /10 - rating number after 1 year (1 - year exposure data).
\rating number after one year -
rating number after two years (2 years of exposure).

PAINT SYSTEM:	G	H	I	K
CONSTANT	2.69 (1.31)*	0.60 (1.03)	3.54 (1.22)**	3.50 (1.06)**
EXP.2 YEAR (yes=1, no=0)	- 0.90 (0.25)**	- 0.08 (0.20)	0.45 (0.23)+	- 1.81 (0.20)**
TOW x 10^{-4} (h)	- 4.56 (1.74)*	1.76 (1.37)	- 1.42 (1.62)	- 1.55 (1.41)
NO_2 x 10^{-2} ($\mu g/m^3$)	0.25 (1.01)	- 0.34 (0.80)	- 0.56 (0.94)	- 1.04 (0.82)
SO_2 x 10^{-2} ($\mu g/m^3$)	- 1.54 (1.17)	- 0.72 (0.93)	- 1.27 (1.10)	- 0.37 (0.95)
PREC x 10^{-4} (mm)	2.74 (4.09)	7.35 (3.22)*	- 5.24 (3.82)	- 4.35 (3.31)
TEMP (^0C)	0.06 (0.05)	0.01 (0.04)	0.12 (0.05)**	0.08 (0.04)+
pH	- 0.17 (0.27)	- 0.10 (0.22)	- 0.58 (0.26)*	- 0.18 (0.22)
SO_2/NO_2 RATIO	0.49 (0.37)	0.25 (0.29)	0.37 (0.34)	0.31 (0.30)
SIGNIFICANCE LEVEL OF REGRESSION	0.02	0.11	0.05	<0.01
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.37	0.30	0.33	0.75
NUMBER OF VALID OBS.	45	45	45	45

Symbols:
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+ Coefficient is significantly nonzero on univariate level between 0.1 and 0.25.

Interpretation of coefficients:
A coefficient with positive sign - with higher value of environmental variable, higher difference between the rating numer of the preceeding and the next year, e.g. worsening.

B: FUNGUS, regression on Δ = /10 - rating number after 1 year (1 - year exposure data).
\rating number after one year -
rating number after two years (2 years of exposure).

	G	H	I	K
CONSTANT	-0.03 (1.14)	2.07 (1.45)	2.89 (1.27)*	- 0.17 (0.19)
EXP 2 YEAR (yes=1, no=0)	-0.31 (0.20)	0.23 (0.26)	- 0.78 (0.22)**	- 0.07 (0.34)*
TOW x 10^{-4} (h)	1.46 (0.85)+	0.62 (1.09)	3.45 (0.95)**	0.18 (0.14)
NO_2 x 10^{-2} ($\mu g/m^3$)	0.41 (0.78)	- 0.54 (1.00)	- 0.32 (0.87)	- 0.18 (0.13)
SO_2 x 10^{-2} ($\mu g/m^3$)	0.20 (1.02)	0.01 (1.30)	0.22 (1.13)	0.15 (0.17)
PREC x 10^{-4} (mm)	4.92 (3.49)	2.65 (4.44)	7.46 (3.89)*	0.26 (0.58)
TEMP (^0C)	0.02 (0.04)	0.01 (0.05)	0.01 (0.04)	- 0.01 (0.01)
pH	- 0.10 (0.20)	- 0.38 (0.25)	- 0.45 (0.22)*	0.06 (0.03)+
TOTAL NITROGEN	- 0.16 (0.10)	- 0.02 (0.12)	- 0.14 (0.11)	0.01 (0.02)
SO_2/NO_2 RATIO	0.16 (0.29)	0.04 (0.37)	- 0.05 (0.32)	- 0.06 (0.05)
SIGNIFICANCE LEVEL OF REGRESSION	0.62	0.44	<0.01	0.24
R^2-COEFFICIENT (EXPL. VARIABILITY)	0.14	0.16	0.37	0.21
NUMBER OF VALID OBS.	55	55	55	55

Symbols:
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Interpretation of coefficients:
A higher coefficient with positive sign - with higher value of environmental variable, higher difference between the rating numer of the preceeding and the next year, e.g. worsening.

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TITTEL
Results from evaluation of decay of painted systems for wood, steel and galvanized steel after 1 and 2 years exposure

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TITLE

ABSTRACT (max. 300 characters, 7 lines)
The results of the 1 and 2 years of exposure of the painted systems for steel and wood is presented for all test sites in the exposure programme. A general description of the results together with a statistical treatment was performed. The damages were mainly observed on the parameters general appearance, dirt, chalking and fungus, for the steel samples also for damages in and around an artificial cut. The damages were generally small and dose-response relationships are difficult to find after such a short time as 2 years. Slight indications for increasing degradation were observed for the parameters SO_2, NO_2, precipitation and time of wetness, for chalking sunshine had influenced damage.

Kategorier: Åpen - kan bestilles fra NILU A
Må bestilles gjennom oppdragsgiver B
Kan ikke utleveres C