

Cleaning of Aluminium in the Building Industry



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1. Introduction

Aluminium is widely used in the building industry because it offers a combination of light weight and high strength, good formability and high resistance to weathering together with a diversity of methods to produce decorative surface appearances. Aluminium components can be used with an untreated, an anodised or a coated surface depending on the specific requirements. The surfaces of all materials used for architectural purposes are subjected to the same natural fouling as a result of atmospheric conditions. Façades lose their original decorative appearance and become unsightly with time. At the same time, the fouling increases the risk of corrosion. It is therefore necessary to clean decorative façades:

- to maintain their decorative appearance and
- to minimise the risk of corrosion by removing the fouling.

Tips on how to carry out such cleaning operations and the use of neutral cleaning agents (pH 5 to 8) are given below.

2. Definition of cleaning and terms used

The primary cleaning operation has to be carried out before acceptance of the work. The cleaning measures adopted depend on the actual degree of fouling of the aluminium components and the results of a trial cleaning operation. The period between cleaning operations depends on the actual decorative requirements placed on the façade and the time taken for fouling to reappear as a result of local immissions.

Generally speaking, the following definitions apply:

- **Primary cleaning**
The term “primary cleaning” is used to describe the cleaning operation carried out after the building has been completed and before the acceptance of the work in order to remove dirt from the building operations and fouling from the atmosphere.
- **Basic cleaning**
The basic cleaning is an abrasive clean that is carried out if the façade has not been cleaned for several years.
- **Periodic cleaning**
A periodic clean is a cleaning operation that is carried out at regular intervals after the primary or basic cleaning operation.

3. Untreated components

Untreated rolled or extruded aluminium surfaces that are not subjected to any decorative requirements form a natural oxide layer, whose thickness increases with time under the influence of the atmosphere. This protective oxide layer, which can grow to a thickness of about 0.1 µm, usually has a dull light grey appearance. Depending on the location, the entrapment of dirt and dust leads to it becoming uniformly somewhat darker. This greying of the surface is often regarded as being positive (e.g. for antiglare purposes). Cleaning is thus undesirable and not necessary thanks to aluminium’s good resistance to weathering.



The roof of the Westfalenhalle in Dortmund, which was built in 1952, exemplifies how untreated aluminium surfaces can withstand the elements without any difficulty. (Fig. 1)

4. Anodised components

4.1 General

The oxide layer produced artificially by the anodising of aluminium is some 200 times thicker than the natural oxide layer. It enables the original surface appearance of components to be maintained permanently. Practical experience has shown that surfaces being anodised and sealed in accordance with DIN 17611 or EN 12373-1 are resistant to the elements. Anodised components that have been exposed to the weather for decades are proof of this. Even anodised components suffer from fouling over time and this can impair the part's decorative appearance. That is why façades, doors, window frames etc. should be cleaned from time to time. There is no hard and fast rule covering the periods between cleans. The controlling factors are the degree of fouling – which will depend on the location – and the requirements regarding the decorative appearance of the components. This determines the cleaning measures adopted (Table 1) and the frequency of cleaning, e.g. once or several times a year.

(Table 1) Cleaning of anodised surfaces

Cleaning Operation	Abrasive	non- abrasive
Primary cleaning	X	(X)
Basic cleaning	X	
Periodic cleaning	(X)	X

X = obligatory, (X) = optional

4.2 Primary cleaning / basic cleaning

Just like basic cleaning, primary cleaning should be carried out abrasively with a light mechanical removal of the surface, in an analogous manner to the removal of heavy fouling. The cleaning of the façade is always carried out in separate stages from the top to the bottom, whereby the measures used are chosen in accordance with results of the test clean on a sample:

- Washing with water containing a wetting agent using a sponge, scrubbing brush or suitable cleaning pad
- Rubbing the surface thoroughly with a suitable abrasive cleaning agent and/or suitable cleaning pad
- Washing away any residues from the cleaning agent
- Subjecting the surface to post treatment with a preserving agent and polishing carefully

Applying the necessary contact pressure in the direction of rolling or extrusion produces the desired cleaning effect. For practical purposes, cleaning should not be carried out in direct sunlight. Any applicable regulations regarding use and safety have to be observed.

Abrasive cleaning agents containing finely ground neutral polishing agents (Type I) are used. Traces of these mostly white polishing agents should not be left on the surface or in gaps or crevices of aluminium façades or window or door profiles because they can form ugly crusts there; this can mar the optical effect, especially with dark shades of colour. Rinsing with water to which a neutral wetting agent has been added is therefore necessary.

Cleaning can be equally carried out effectively using an abrasive scouring pad (e.g. Scotch-Brite, Type A) together with a non-abrasive cleaning agent.

After cleaning, the surface can be treated with a cleaning agent that contains a preserving agent that leaves a water-repellent film on the cleaned surface (Type II). It is also possible to use a cleaning agent that is abrasive and produces a water-repellent effect (Type I b).

The primary cleaning and the basic cleaning operations form the basis for subsequent periodic cleaning, so that the decorative appearance of the components is maintained.

4.3 Periodic cleaning

4.3.1 General

The frequency and nature of periodic cleaning depend on the degree of fouling and the demands placed on the decorative appearance of the façade.

4.3.2 Light fouling

Light fouling should only be removed using a sponge, a cloth and water, to which a neutral wetting agent should always be added. After cleaning, the surface should be rinsed thoroughly with water. Soapsuds should not be used because of their high alkalinity.

If necessary, high-pressure cleaning equipment can be used. This should be used in such a way that the natural flow direction for water running off the façade construction is adhered to and no water forces its way into the façade. The use of high-pressure cleaning equipment thus has to be adapted to the actual construction. Any applicable health and safety regulations have to be observed.

4.3.3 Heavy fouling

In the case of heavy fouling, abrasive cleaning is carried out in a manner analogous to the basic cleaning operation described in Section 4.1.

4.3.4 Oily and greasy fouling

A special cleaning agent (Type III) should be used if the fouling contains oily or greasy substances.

5. Plastic coated and foil laminated components

5.1 General

Aluminium surfaces are coated organically to give them – as with anodised aluminium – a decorative appearance and provide additional corrosion protection. Weather resistant paint systems are used and applied to the prepared surface. The preparatory treatment involves cleaning and pickling the surface and then applying a conversion layer. The quality features of these paints are their colour fastness, which depends on the colouring pigment used, and their residual lustre.

5.2 Primary cleaning / periodic cleaning

5.2.1 General

Primary cleaning and subsequent periodic cleaning are carried out using the following cleaning steps:

- Washing with water containing wetting agents
- Cleaning with a neutral cleaning agent suitable for the specific paint system using a sponge or soft brush
- Rinsing using water containing additions of a preserving agent
- Removing water with a window squeegee and/or leather.

5.2.2 Light fouling

Cleaning and preservation of organically coated façades should be carried out at least once a year. Deposits of dirt can then be easily removed without difficulty with a sponge and water containing wetting agents. In the case of coatings containing metallic-effect pigments, cleaning may need to be carried out every six months in certain circumstances.

5.2.3 Heavy fouling

The cleaning operation described in Section 5.2.2 is insufficient to remove heavy fouling and oily residues. In such cases, one should use special cleaning agents capable of removing fouling or grease that do not, however, attack the painted layer in a detrimental manner. Their suitability should be carefully checked by conducting a test clean on a sample (see also Section 5.3).

5.3 Basic cleaning

Painted surfaces that have been exposed to the elements for years without cleaning have to be subjected to a basic cleaning. One has to carry out a test clean on a sample area to check whether one can achieve a satisfactory cleaning effect using the cleaning agents available. Dirt and chalk products should be removed using appropriate special abrasive cleaning agents, e.g. polishing pastes (Type I b) similar to car polish. A lot of work is involved in producing a uniform surface appearance on components with a large surface because of the ease of producing cloudiness. Abrasive cleaning agents should not be used on coatings containing metallic-effect pigments.

6. Cleaning agents

6.1 General

Cleaning agents have to be suitable for the specific cleaning operation. In determining the suitability of a cleaning agent, its cleaning effect might be an important criterion but not the decisive one. A critical factor is the requirement that the surfaces to be cleaned by the cleaning agent should not be damaged. Cleaning agents should always be chosen specifically for the anodised or coated surface. However, there should not be any damage to any other materials used in a building such as sealants, plastics, glass, etc.

A list of the neutral cleaning agents produced in collaboration with the GRM (cf. Section 7) is available on request from the GDA.

6.2 Cleaning agents for anodised components

6.2.1 General

Cleaning agents that chemically attack the oxide layer should not be used with anodised surfaces. Fluorides, chlorides and sulphates have a detrimental effect. The cleaning agents must have a pH in the range of 5 to 8 where they are chemically neutral. The use of substances that cause scouring or scratches, such as emery paper, steel wool or wire brushes, is not allowed.

The chemical industry has developed special cleaning agents that fulfil the cleaning and care-related requirements and rule out any risks when used properly (cf. Section 6.5 "Non-neutral cleaning agents")



Highly water-repellent surface with little wetting following use of a Type I b or Type II cleaning agent (Fig. 2.1)

6.2.2 Abrasive cleaning agents, Typ I a

■ Range of application

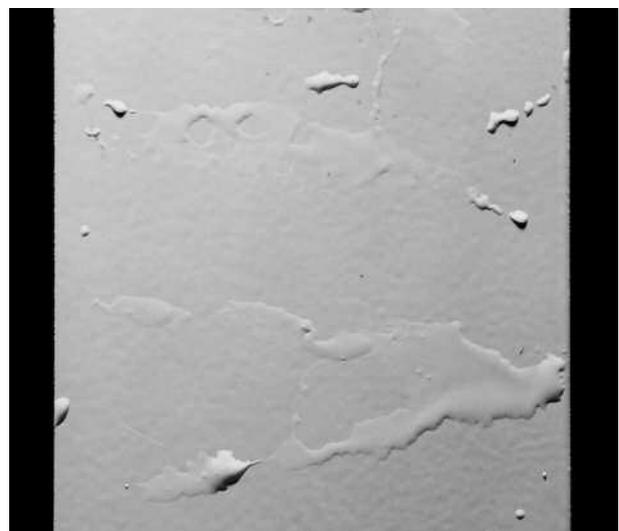
Primary cleaning, basic cleaning

■ Requirements

The abrasive cleaning agent removes heavy and tenacious fouling as well as fouling containing slight amounts of grease. The cleaning agent (pH between 5 and 8) should not contain any acidic or alkaline substances. The solvents and finely distributed abrasive present in the cleaning agent should be effective chemically and mechanically without there being any noticeable attack of the oxide layer. Any cleaning agent residues have to be readily removable by washing in water. One has to avoid any detrimental effects in materials associated with the object being cleaned, e.g. sealants, glass etc.

■ Method of use

The surface should be rubbed vigorously with a cleaning cloth soaked in the cleaning agent, and the cloth should be replaced frequently. A slightly abrasive bonded-fibres pad (e.g. Scotch-Brite, Type A, red) can be used equally successfully. Under certain circumstances, cleaning can also be carried out by careful use of an orbital sander and bonded-fibres pad. Afterwards, the surface has to be rinsed thoroughly with clean water, for which a pressure washer can be used. Attention should be paid to the manufacturer's directions for use.



Poorly water-repellent surface with a high degree of wetting following use of a Type I a cleaning agent without any post treatment (Fig. 2.2)

6.2.3 Abrasive cleaning agents containing preserving agents, Typ I b

■ Range of application

Primary cleaning, basic cleaning

■ Requirements

In addition to cleaning and abrasive components, this cleaning agent contains substances that leave a protective film on the surface; the film is water and dirt repellent and thus provides temporary protection for the surface against atmospheric effects (cf. Fig. 2.1 and Fig. 2.2). It should be free from any substances that can react with weathering effects and lead to the formation of iridescent deposits on the surface. The cleaning agent (pH between 5 and 8) should not contain any acidic or alkaline substances. One has to avoid any detrimental effects in materials associated with the object being cleaned, e.g. sealants, glass etc.

■ Method of use

Spread the Type I b abrasive cleaning agent evenly over the surface by rubbing. In doing so, any adherent residues and dirt should be completely removed, as should any abrasive from the cleaning agent, otherwise these will become covered over by the water-repellent substance. This should be borne in mind when carrying out the test clean on a sample. Attention should be paid to the manufacturer's directions for use.

6.2.4 Non-abrasive cleaning agents containing preserving agents, Typ II

The cleaning agent is non-abrasive. In addition to organic solvents it contains substances that produce a water-repellent film on the surface, cf. Section 6.2.3. This temporary protective film helps make periodic cleaning easier.

■ Range of application

Periodic cleaning, subsequent treatment of the anodised surface after primary cleaning or basic cleaning.

■ Requirements

The cleaning agent helps remove light to average fouling. It leaves behind a water-repellent, temporary protective film on the surface. The cleaning agent (pH between 5 and 8) should not contain any acidic or alkaline substances. It should be free from abrasive substances. It should not contain any waxes and should be easy to process (without forming streaks). One has to avoid any detrimental effects in materials associated with the object being cleaned, such as sealants, glass, etc.

■ Method of use

The cleaning agent is applied evenly and thinly. It has to be rubbed very carefully so that only an extremely thin water-repellent film remains on the surface and the formation of unsightly streaks is avoided (cf. Fig. 3.1 and Fig. 3.2). The manufacturer's instructions for use should be followed.



Trouble-free surface treated with a Type II cleaning agent (Fig. 3.1)



Streak formation resulting from uneven distribution of a Type II cleaning agent (Fig. 3.2)

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6.2.5 Special cleaning agents, Typ III

Special cleaning agents for surface-treated aluminium parts are formulated in such a way that they can be diluted with water to any degree required and thus also processed mechanically using high-pressure equipment. In addition to active cleaning ingredients they contain solvents for grease, which are chosen in accordance with the surface to be treated.

■ Range of application

Anodised, plastic coated and enamelled surfaces.

■ Requirements

The special cleaning agent is used in particular to remove grease- and oil-containing fouling. It should not contain any acidic or alkaline substances (pH between 5 and 8). It should be free from abrasive substances. The loosened fouling should be readily removable by washing. One has to avoid any detrimental effects in materials associated with the object being cleaned, e.g. sealants, glass etc.

■ Method of use

Depending on the degree of fouling, dilute with water and after application rub with a cleaning cloth. Finally wash thoroughly with water. High-pressure cleaning equipment can also be used here. Attention should be paid to the manufacturer's directions for use.

6.3 Cleaning agents for plastic coated components

If organically coated components are not cleaned every year, the amount of effort required to clean them increases with increasing time between cleans, and chalking causes cleaning problems. Façades that have not been cleaned for years can only be cleaned using mildly abrasive cleaning agents similar to car polish. The cleaning agents should not have any detrimental effect on the coating,

either mechanically or chemically. They have to be free from solvents that could etch the lacquer. Abrasive cleaning agents should not be used on coatings containing metallic-effect pigments.

6.4 Overview of cleaning agents to be used

Table 2 provides a schematic aid to selecting suitable cleaning agents for anodised and organically coated surfaces.

6.5 Non-neutral cleaning agents

The use of non-neutral cleaning agents with pHs below 5 (acidic) or above 8 (alkaline) needs to be considered very carefully. These products have a chemical effect on the surface layer, i.e. there is a risk of damage to the layer with anodised as well as with coated components.

Furthermore, the use of non-neutral cleaning agents means an additional corrosion risk for galvanised fixtures and thus presents a safety risk for the support structure of the metal façade (expert opinion of the BAM, Bundesanstalt für Materialforschung und -prüfung, (Federal Institute for Materials Research and Testing, Berlin).

It is recommendable and practical to check the pH of a cleaning agent at the concentration to be used with a pH paper strip and to determine the suitability of the cleaning agent for the specific surface layer by carrying out a simple immersion test. A sheet sample is immersed half way in the cleaning agent. Immersion time and test temperature can be varied. The immersed and non-immersed test surfaces are then compared. Changes to surface layers can be measured: in the case of anodised layers by measuring the admittance y_{20} , in the case of organic layers by measuring the lustre and colour.

[Table 2] Aid to selecting cleaning agents

Surface	Degree of Fouling	Cleaning agent			
		Neutral Wetting Agent and Water	Abrasive Cleaning Agent Typ I a, I b	Non- abrasive Cleaning Agent with Preservative Typ II	Non- abrasive Special Cleaning Agent Typ III
anodised	light	X		X	
	average		X	(X)	
	heavy		X	(X)	
	oily			X	X
coated	light, average	X		(X)	
	heavy, oily		X ¹⁾	(X)	X
X = obligatory, (X) = optional, 1) not for coatings with metallic-effect pigments					
Abrasive cleaning agent or bonded-fibres pad (e.g. ScotchBrite, Typ A)			(Typ I a)		
Abrasive cleaning agent containing preserving agents			(Typ I b)		
Non-abrasive cleaning agent containing preserving agents			(Typ II)		
Special cleaning agent containing solvents for oils and greases			(Typ III)		

An immersion test can also be used to determine how compatible a non-neutral cleaning agent is with other materials used on the building site, such as hot-dip galvanised steel, Cr-Ni steel, coated glass, plastic, sealant, stone etc.

7. Quality assurance

The "Gütegemeinschaft für die Reinigung von Metallfassaden e. V." (GRM, Quality Association for the Cleaning of Metal Façades; Marientorgraben 13, Nürnberg, Germany) was recognised by RAL in 1987. The use of neutral cleaning agents (pH 5 to 8) that have been tested and approved by the GRM (cf. Section 6) is a prerequisite for a quality approved façade cleaning in accordance with RAL GZ 632. The quality approved cleaning operation is carried out in prescribed cleaning steps in accordance with relevant cleaning class.

8. Protection and cleaning during construction and installation work

Aluminium components should not be subjected to scratching and impact. They should only be installed once masonry work, stucco work, plastering, stonework and slab-laying has been completed in order to prevent any damage to the surface, e.g. due to lime or cement splashes. These building materials are alkaline and attack the anodised oxide layer, especially during the period when they are setting. Splashes have to be washed down immediately with plenty of water. If they are allowed to act on the anodised layer for a long period, etching can start to take place; this first becomes evident as the formation of whitish patches, which can lead to perforation of the oxide layer (efflorescence). One can only rectify heavy damage – if at all – by removing the corroded parts, pickling the oxide layer, mechanically treating the surface and anodising the part again!

The pH of freshly cast concrete and mortar as well as of products containing asbestos cement is over 10; the pH of saturated lime water can even reach 12. Even after several months, rainwater can dissolve alkaline components from, for example, exposed aggregate concrete or unprotected asbestos cement products. Aluminium parts are also at risk as a result of the acid treatment of stone façade parts and have to be protected.

Depending on the surface finish (anodised, coated), the following possible methods are available for protecting decorative surfaces against cement-bound building materials during the construction and installation phase:

- Masking with a suitable self-adhesive protective film, which has to be UV-resistant. The protective film should only remain on the surface of the component for a limited period of time because of aging of the adhesive.

Depending on the type of film and the adhesive, the removal of the film can cause problems after about 6 months. Here, too, the removal of adhesive residues can cause problems. Possible use with: anodised aluminium, organically coated aluminium, and glass.

- Use of peel-off paints, which are applied sufficiently thickly in liquid form and then removed at a later date as a solid paint film. The layer thicknesses prescribed by the manufacturer should be observed. If the layer is too thin, it will not be possible to remove it as a coherent film. Here, too, the paint film should not be left on the surface to be protected for an unnecessarily long time.

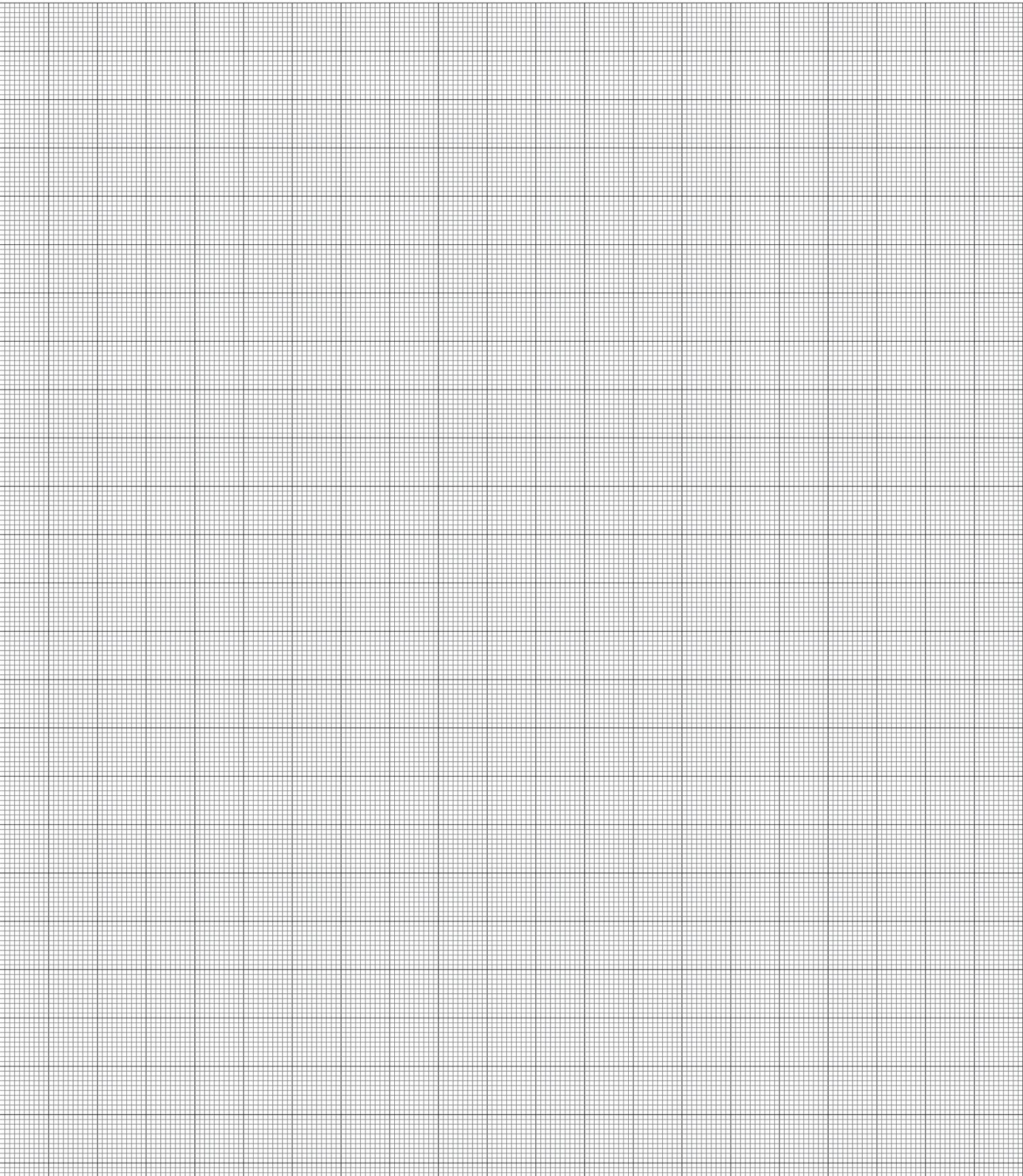
This possible method of protection is not suitable for organically coated surfaces because there is a risk that the solvent of the protective paint system will etch the coated surface. Possible use with: anodised aluminium, glass.

- Application of a deliberately thicker layer of preservation products that can be removed again later using a neutral cleaning agent, such as a product for dissolving greasy fouling. The effectiveness of the protection depends on the formulation of the product, the thickness of the applied layer and the nature of the aggressive medium. Possible use with: anodised aluminium, glass; use with reservations in the case of coated aluminium, in other words only after carrying out a check for suitability.

If the building schedule permits, it is practical to install the components in question only after cleaning-up operations have been carried out and/or to point out to the group of people carrying out cleaning-up work that cement-bound fouling on decorative aluminium surfaces must be washed off immediately with water.

One should make sure that special windowsills have adequate protection against alkaline and acid solutions.

Oily and greasy fouling left behind after installation together with the residues of self-adhesive protective films etc., can usually be removed using solvents (only suitable for plastic coated aluminium components under certain circumstances) or with a Type III special cleaning agent (see Section 6.2.5). In doing so, specific protective measures need to be observed.



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Aluminium for Future Generations



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