Windowcraft – Part Two

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Abstract

The first part of this paper, outlining our work and describing evidence of the performance of old doors and windows in use, was published in the March 2004 issue of this Journal. This second part describes our work in rediscovering the qualities of linseed oil for use in linseed-oil paint, putty, and soap, and our experiences of using these products. Since 1982 our goal has been to investigate forgotten knowledge about linseed-oil paints, expertise which had developed over hundreds of years and which was lost in recent times with the increased use of modern paint systems. In running our own business concerned with the care and maintenance of buildings, we have worked determinedly towards the development of materials that fulfil our requirements in respect of technical properties, drying time, eco-friendliness, storage properties, ease of maintenance, attractiveness, and economy.

Traditional European skills and ancient wisdom, in combination with modern production techniques and cooperation with local farmers, have enabled the development of a totally new generation of linseed-oil products that do not require solvents at any stage of their use.

Background

When we started renovating windows and doors in 1980, they were treated with well-known and recommended paints from Sweden's major paint manufacturers. We were extremely dissatisfied with the results – within a few years the windows needed painting again. Moreover, the paints contained solvents, such as turpentine, and other additives that affected our health. This was the start of our quest to find out more about linseed oil and linseed-oil paint.

In 1982 we met the chemist and glass specialist Dr Harry Backman of Glass Control AB in Lund.[1] He encouraged and inspired us in our work over the course of many years, ensuring we had access to the right books and helping us in our search for traditional materials and processes.[2,3,4] We met university lecturer Boris Schönbeck in the following year,[5] and he invited us to give seminars to architecture students at the Chalmers Institute of Technology in Gothenburg. Thanks to his support we gained access to the Institute's library, and also received invaluable help in how to handle documentation.

Linseed-oil paint was used in the painting of buildings during the nineteenth century and up to the early 1960s. Limited access to imported raw materials during the Second World War led to German production of what were called artificial oil paints – alkyd paints – derived from a number of different fatty acids, linseed oil, soya oil, sunflower oil, and waste products from the paper-pulp industry.

As raw linseed oil is a natural or 'living' material, it was difficult to handle in large-scale industrial production. Pre-industrial refined oil was of a very high quality, but its development was limited due to technical problems including cleaning processes and heating techniques.

Modern alkyd paints (alkyd resin + pigment) give a surface treatment that resembles that produced with linseed-oil paint, but with a strictly limited capability to penetrate into the wood. In order to get a paint that is easy to apply, it has to be diluted with a thinner having a capacity to dissolve grease, such as paraffin oil, together with toluene or petroleum spirits (white spirit). These products are classified as highly toxic and it is recommended that they be avoided in the future. In the past 40 years a handful of paint industries in the Nordic region have become dominant in their use of alkyd and acrylic ('plastic') paints. We have a small production of linseed-oil paints in the Nordic countries, but all require large amounts of solvents and are therefore classified as harmful to health and the environment. We needed alternatives!

Paint groups

Over the years, since 1982, we have kept our own records and also learned a lot from everyday life. We often work with windows that are more than 100 years old and have only been treated with linseed-oil paint, and which are still in a very good condition.[6,7]

Windows painted with modern acrylic paint very often turn out to have damage under the surface. The paint only adheres to the surface and does not penetrate. Under the paint the wood is rotten. As the dry-matter content is only about 40 per cent (60 per cent water and chemicals) it is necessary to cover the wood with several paint layers. These are impermeable and trapped moisture degrades the wood.

Alkyd paint has a dry-matter content of about 55 per cent, which means a solvent content of 45 per cent. To be able to paint with it, you need to add a further 10 to 20 per cent of solvent. The alkyd paint is not able to penetrate the surface.

If you use linseed-oil paint without solvents, you have a dry-matter content of 100 per cent and very good penetration. The paint expands during oxidation by an additional 10 per cent. This means that the paint not only adheres to the surface, but also penetrates into and around all the small cracks. This makes the paint very suitable for iron and galvanized sheet-roofing products. Linseed-oil paints are exceptionally water repellent. Over the years, as linseed-oil paint fades, the paint surface becomes more and more open to diffusion. This allows ventilation of the wood and any moisture that may be present can escape.

Tests carried out by Stefan Hjort and Helena Patrikson at the Chalmer's Institute of Technology assessed the moisture-absorbing capacity of a number of different modern paint systems on wooden panelling.[8] Unpainted wooden panelling showed the best results – the moisture-absorbing capacity is considerable, but the drying capacity much greater. It is better not to do anything at all than to do the wrong thing with the wrong material.

A simple way of testing whether linseed-oil paint is greasy, water repellent, and penetrating is to paint on to absorbent brown paper (Figure 1). Draw around a one-litre can, paint within the circle, and wait until the paint has dried. Has the linseed oil been absorbed outside the circle? Has the linseed oil soaked through the paper? Alkyd paints have no penetration ability.

Flax – a traditional crop

Linseed-oil paints have been used for hundreds of years,[9] this extended use providing a source of experience and knowledge that is greater than for all other modern paints. Flax is a traditional crop first cultivated in Egypt more than 5,000 years ago. The plant was grown to obtain linseed oil, but the fibres were also used to make cloth for garments and woven articles. In the Nordic region, traces of linen have been found from the older Iron Age and Viking eras. Right up to the end of the eighteenth century, flax for spinning was one of the most important crops in Europe. At the start of the nineteenth century,

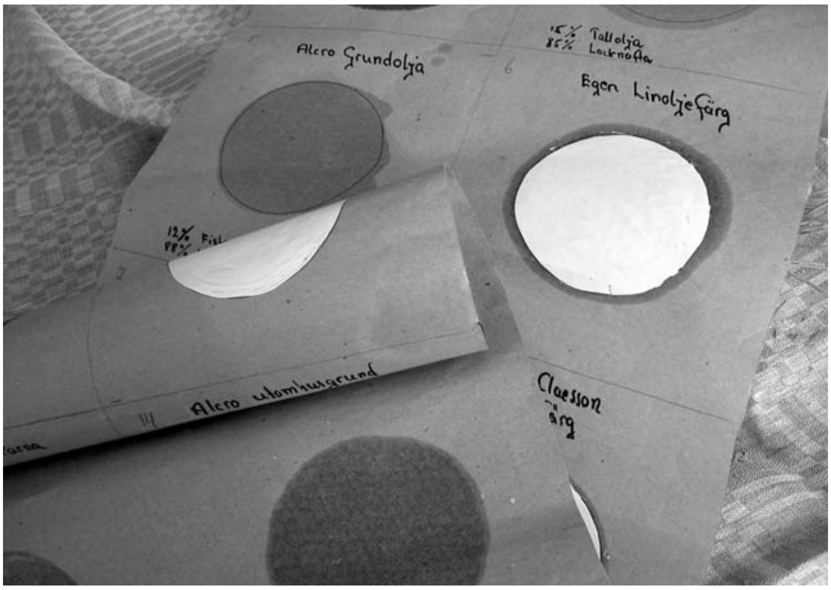

Figure 1 *Penetration tests of different paint qualities on absorbent paper.*

cheap cotton started to become more common and the cultivation of linen flax almost entirely ceased. In the 1940s it became increasingly common to grow flax again, but now for the purpose of extracting linseed oil. Flax (*Linum usitassimum*) has been used as a raw material for textiles, as a binding agent in paints and lacquers, and in foodstuffs, animal feed, and medicines. The Egyptians were aware of the use of flax as a binding agent in paint. Towards the end of the Middle Ages and during the Renaissance, artists such as Cennino Cennini (1360–1437) started to use linseed oil to a greater extent,[10] but it was not until the seventeenth and eighteenth centuries that linseed oil started to be used by craftsmen for painting. Then it was mainly used for churches, castles, and mansions. We now use linseed oil from oilseed flax for impregnating wood and manufacturing paint, putty, linseed-oil wax, and soap. Information about the pre-industrial refining of the oil in Germany can be found in a number of old books from the eighteenth and nineteenth centuries.[11,12,13] It is thus possible to give linseed-oil paints properties that fulfil all possible requirements in respect of technical properties, drying time, storage, ease of maintenance, appearance, and economy.

Flax for linseed oil

We differentiate between the two basic types of flax – oilseed flax and spinning flax. Oilseed flax grows with shorter fibres and produces seeds that are rich in oil. In contrast, spinning flax has longer fibres, but less oil in its seeds. Linseed oil is a drying oil that oxidizes in contact with the air. Both soil type and climate affect the composition of the oil. A cold and damp climate results in oil that is high in linolenic acid. The linolenic acid contributes to a faster drying of the linseed oil and thereby the paint. Oilseed flax can be cultivated throughout the world, but the linolenic acid content is highest in flax from the northern latitudes: Sweden, the Baltic states, and Russia (Table 1). As a by-product of pressing we obtain linseed cake, which is rich in protein and used as an animal feed. The stalks can be used as an insulating fibre.

Pressing and refining raw linseed oil

We use raw cold-pressed linseed oil from local farmers close to us in Ystad, Skane, in the south of Sweden.

Seventeen years ago we were fortunate to meet Jan Greger Persson, a young farmer who was interested in growing flax. It was important

Figure 2 *Flax, seeds, linseed pellets, and linseed-oil impurities.*

	Uruguay	India	USA	Mexico	Germany	Argentina	Sweden
Iodine value	173	177	179	182	182	185	194
Saturated fatty acids	12	11	11	10	9	9	9
Oil acids	26	24	24	23	24	22	15
Linolic acid	15	16	15	14	16	16	19
Linolenic acid	47	49	50	53	51	53	57

Table 1 *Fatty acid composition in % weight and iodine value of linseed oil from seven different countries.*

for us to have access to a local, high-quality product. This oil is clean and pale, with small quantities of impurities. The drying time is about 24–36 hours. If the seeds are heated and ground, more oil can be pressed from them, but this creates a considerable quantity of impurities. This makes the oil darker and the drying time longer (i.e. 4–5 days). In reading old books about the refining of linseed oil, one becomes aware of an ongoing theme from century to century – linseed oil should be pure.[14,15,16,17,18] To fulfil our requirements concerning quality and durability, we require full control over the type of seed, quality of soil, place of cultivation, pressing, storage, and processing. That is why it is important to have local growers with capacity for the future.

It is also possible to find chemically extracted linseed oil imported from different countries and latitudes. This oil is very dark and dirty, made from crushed seeds together with a quantity of solvents. It has an unpleasant smell and a very long drying time. It is also very difficult to make a satisfactory white paint from this oil – the painted surface will yellow after some time, particularly in dark spots.

It is possible to produce linseed-oil paint from raw linseed oil, but then the choice of pigment is limited and the drying time will be long. To increase viscosity and shorten the drying time to about 24 hours, it is possible to refine linseed oil to what is termed 'boiled' linseed oil (i.e. an oxidized linseed oil). Many different methods are referred to in old books, including long-term storage, heating of the oil together with some substance that gives off oxygen (e.g. lead oxide), or blowing through it with air

Linseed-oil paints – on indoor and outdoor wood

We produce linseed-oil paints from boiled, cold-pressed Swedish linseed oil. The white paints contain zinc oxide and titanium dioxide. The colours are made from metal oxides and earth pigments. The linseed-oil paints can be used indoors and outdoors on wood, metal, and plastic. Linseed-oil paints age visibly, and we often refer to 'natural signals'. The paint starts to fade after about six to eight years, depending on the aspect of the painted area and how exposed it is. After a further period of time, about 10–15 years, the paint becomes chalky as the pigment seeps out. If nothing is done the surface will begin to crack after about 20–30 years.

Depending on position and exposure, maintenance is usually simple. Just clean the surface with, for example, ammonia or ethanol and let it dry. A brass brush can also be used. If the surface is brushed and cleaned and fresh boiled linseed oil or linseed-oil wax is applied, the surface will regain its former gloss and function (Figure 3). In the case of surfaces that are painted white, add a little white-colour pigment (titanium dioxide) to avoid the surface yellowing.

Figure 3 *Maintenance of an old door, after nine years, with boiled linseed oil or linseed-oil wax.*

When handling linseed oil there is always a risk of self-ignition in porous material. Soak rags in water and dispose of them.

A good linseed-oil paint can cope well with today's environment. It can also be made self-cleaning through controlled chalking: after some years the pigments in the white and light colours, titan and zinc oxide, rise to the surface and are then dispersed along with particles of dirt.

If the paint has insufficient linseed oil (which is serving as the binding agent) in relation to pigment, it will appear dull from the start. If, in addition, it is thinned with large quantities of solvents, it becomes even more dull, and this thinning results in the paint chalking faster and having a short life. The drying process of linseed-oil paint by oxidation proceeds constantly and makes even gloss paint dull in the end, but this takes many years. This is a positive and clear signal to start maintenance.

We also use raw cold-pressed linseed oil for impregnation of bare wood. To ensure that there will not be an excess of oil in the wood, heat the oil to approximately 60°C. Alternatively, apply the oil to the surface whilst using a heat gun.

The term 'linseed-oil paint' serves as a collective name for many different products using linseed oil as a binding agent. It is therefore important to ask what result you are looking for. Decoration, protection, or both? Indoor or outdoor application? How long should it last? When you have defined your needs, you can choose the materials. Since there are no common definitions or standards relating to linseed oil or linseed-oil paint, there is much confusion.

Good-quality linseed-oil paint is very easy to apply. We have developed a single-pot system where you just choose the colour and use this indoors and outdoors for all coats without the addition of any solvents. This system means there are no leftovers of primer or topcoat.

When it is to be repainted, the surface must be clean and dry. The moisture content in the wood should be no more than 14 per cent. If the paint is to be applied to bare wood, this should first be impregnated with raw linseed oil. The oil should be worked well into the wood. Hot oil (at about 60°C) penetrates more easily into the surface. During painting, the temperature must be at 5–25°C.

You can use linseed-oil paint on all surfaces that are clean and dry, such as wood, iron, glass, and alkyd-painted surfaces. Stir the paint thoroughly before using. The paint should not be diluted with solvents. If necessary, thin with a maximum of 5 per cent boiled linseed oil.

Work the paint well into the wood. Paint in several directions before the last, long stroke of the paintbrush. Use a stiff natural-bristle brush. Apply several coats to give full coverage. Use linseed-oil soap for cleaning brushes and hands. If you paint with the same colour, you do not need to clean the brushes afterwards. Just store them by immersing them in raw linseed oil in a jar. The paint can be stored for many years.

Over the span of several centuries a European standard for the drying of linseed-oil paint has been developed. Application of one coat per day is considered satisfactory. Time for drying is 24 hours. As mentioned above, the drying of linseed-oil paint is affected by the quality of the linseed oil, by refining, manufacturing, temperature, ventilation, daylight, air humidity, the absorption capacity of the surface, and the thickness of the paint layer.

To find out what type of paint has been used previously, you can moisten your thumb with spirit and press on to the paint surface for a few seconds. If the surface feels sticky, like contact adhesive, it is some form of acrylic paint. Stroke raw or boiled linseed oil on to the paint surface. If the surface then regains its shine and the pigment its former strength, it is probably some form of linseed-oil paint. Doubt can arise where the paint is a mixture of alkyd and linseed oil. Pure linseed-oil paint becomes dull with time, chalky after a further period of time, and then cracks into very small squares that stay fixed in place. This takes about 20 years. Alkyd paints become dull with time and, without warning, can come away in large flakes.

Linseed-oil paint requires a brush that has a certain amount of resistance, which makes it possible to spread the paint out to a suitable thickness. A synthetic brush with a soft top for water-based paints and thin varnishes slips over the linseed-oil paints. Best is an old-fashioned pig-bristle brush.

A surface painted with linseed-oil paint can on contact appear to be sticky and not dry. To test whether the surface is dry enough to paint and use, press your thumb hard against the surface and twist. If the paint twists too it is not dry enough. Do not be fooled – the greatest noticeable drying takes place in the final stages of the drying process.

White linseed-oil paint of poor quality can yellow considerably. Linseed-oil paint of good quality yellows very little and then only in the absence of daylight (e.g. under a flowerpot). The yellow tinge disappears if the patch is exposed to daylight. This phenomenon is partly dependent on the quality of the linseed oil.

Old linseed-oil paint (i.e. from the 1800s) often contains lead in the form of white lead oxide (lead white). Extensive paint removal is thus hazardous to the environment and health. It is therefore better not to remove the paint in this situation. Clean the surface and paint it with lead-free, linseed-oil paint. The replacement of the positive characteristics of lead oxide in linseed-oil paint was long ago achieved with zinc oxide. A good linseed-oil paint can cope well with today's environment. It can also be made self-cleaning through controlled chalking: after some years the pigments in the white and light colours, titan and zinc oxide, rise to the surface and are then dispersed along with particles of dirt.

Linseed-oil temperature boundaries

The following temperatures are relevant to the use of linseed oil:

Viscosity limit	60ºC (the oil becomes like water)
Smokes at	150ºC
Ignition	220ºC
Boiling point	300ºC

Study of emissions from linseed-oil paints

Exposure during occupational use

A study was undertaken by Eva Nyman of Tekomo AB to establish possible exposure and emission risks, and resulting health hazards, associated with linseed-oil paints produced by Allbäck Linseed Oil Products Limited.[19]

The study began with an investigation of emissions during the renovation of windows in a residential apartment. The criteria for measurement were based on issues of industrial hygiene – in other words they were designed to examine the exposure to the emissions of the person applying linseed-oil paint.

The subject was a first-floor apartment, Kung Oscars väg 5 B, in Lund (Sweden). This is an older-style apartment, comprising one room with a bed recess and a kitchen, within a property built during the 1930s. The apartment has two windows facing a courtyard. Ventilation is by natural means only.

The investigation comprised control measurements (i.e. before painting commenced) and two subsequent measurements taken during the impregnation/priming and painting of the window cills and frames. The measurements were carried out on three separate occasions in connection with the following stages of work:

- Control measurement – stationary sampling in the centre of the living room.
- Measurement during impregnation/priming using raw, cold-pressed linseed oil of the lower part of the frames and the window cills, coating the knots with shellac, painting the frames and window cills with linseed-oil paint – sampling equipment located in the respiration zone of the craftsman.
- Measurement during painting of frames, casements, and cills with linseed-oil paint – sampling equipment located in the respiration zone of the craftsman.

Sampling was undertaken using a Scantec air pump fitted with adsorption tubes (Tenax® for volatile organic substances and silica for aldehyde).

The results are shown in Table 2.

These results were compared with the hygienic limits of the Swedish National Board of Occupational Safety and Health (Arbetarskyddsstyrelsen), which are shown in Table 3.

The measurements were only carried out during impregnation/priming and painting to investigate the maximum exposure in respect of the linseed-oil products. Given these conditions, we were able to establish that the exposure was considerably below the established hygienic limits for all the substances that the craftsman/painter was exposed to, minimizing the risk of both acute and chronic health problems.

Sampling	**VOC (mg/m³) (~ terpenes)**	**Aldehyde (mg/m³)**			
		Formaldehyde	*Acetaldehyde*	*Acetone/ acrolein*	*Propanal*
Control	154	–	–	–	–
Impregnation / priming	774	–	–	–	–
Painting	330	12	16	42	66
Outdoors	91	–	–	–	–

Table 2 *Exposure during occupational use.*

Chemical	**Time-weighted exposure value (1 working day, μg/m³)**	**Short-term exposure value (average for 15 mins, μg/m³)**	**Ceiling exposure value (highest level for 15 mins, μg/m³)**
Terpenes (Pinene, Carene)	150,000	300,000	–
n-Butanol	45,000	–	90,000
Formaldehyde	600	–	1,200
Acetaldehyde	45,000	90,000	–
Acetone	600,000	1,200,000	–
Acrolein	200	700	–
Propanal	–	–	–

Table 3 *The Swedish National Board of Occupational safety and Health's hygenic limits.*

Further, we were able to establish that a large part of the exposure to volatile organic compounds (VOCs) did not emanate from the linseed-oil products that were used for priming and painting of the window frames, but from the actual wood when removing old paint layers with a hot-air gun. As timber is warmed, it releases terpenes, the natural solvents in the timber, which can clearly be seen in the results from the measurements made during impregnation/priming.

Normally the work of renovating old windows is varied, comprising both carpentry and painting in turns, which in practice means considerably lower exposure than was measured in this case.

It should be added that, in spite of a minimum of air exchange (i.e. natural draught ventilation), the limits were not exceeded.

Emissions test of linseed-oil paint

This study was undertaken by Eva Nyma and Sweden's Research and Test Institute in Borås as part of the continued investigation of linseed-oil paints produced by Allbäck Linseed Oil Products Limited with the intention of mapping out possible exposure and emission risks, together with health hazards and other problems.[20]

The aim of this particular study was to investigate white linseed-oil paint (representative of other shades) in respect of emission tendencies, through standardized emissions measurements according to the trade standard of the Swedish Paint Manufacturers' Association

(SVEFF) *Chemical Emissions from Paint and Varnish*. Tests were carried out, based on emissions data, after 4 and 26 weeks.

Based on the results of the emissions test and other studies (toxicological and olfactometric) from the Working Environment Institute (Arbetsmiljö institutet) in Denmark, the results in respect of the emission factor for total volatile organic compounds (TVOC) were as follows:

- 4 weeks: TVOC emission factor 64 $\mu g/m^2h$
- 26 weeks: TVOC emission factor 18 $\mu g/m^2h$

When compared with the recommendations of SVEFF, the emission factor was, on average, <100 $\mu g/m^2h$ after 4 weeks and lower (< 40 $\mu g/m^2h$) after 26 weeks. The paint can therefore be considered as a very low emitting paint.

For the purpose of judging the tendency of the paint to produce odours or give rise to health problems, we have taken as a starting point the emission factors for the individual substances that the paint can emit. Results in respect of the emissions of the individual substances were analysed and identified in the same emission testing after 4 and 26 weeks (Table 4).

The theoretical concentration ($\mu g/m^3$) of each substance can be calculated from its emission factor and load factor (painted surface in relation to cubic area) and ventilation in the room according to the following equation:

$$\frac{\text{Emission factor } (\mu g/m^2h) \times \text{load factor } (m^2/m^3)}{\text{Air exchange rate } (n/h)}$$

Chemical	**Emission factor ($\mu g/m^2h$)**	
	After 4 weeks	*After 26 weeks*
Propanoic acid + unidentified substances	10	<5
Hexanal	10	<5
Nonanal	5	5
Formaldehyde	<10	<10
Acetaldehyde	<10	<10
Propanal	24	<10
Acrolein	None	None

Table 4 *Emissions test of linseed-oil paint.*

By comparing the calculated theoretical concentration with the odour threshold and irritation levels (VOC-base AMI Denmark) of the Danish Working Environment Institute (Arbetsmiljöinstitutet) for the individual substances, we are able to assess the risk of odour and health problems (i.e. irritation) caused by emissions from the paint.

The calculation of theoretical concentration has been made for two individual substances: nonanal, with the lowest odour-threshold value, and formaldehyde, with the lowest irritation-threshold value. The calculations were based on the emission factors for nonanal and formaldehyde when tested at 26 weeks and in various conditions as set out in Table 5.

All calculated values are clearly under the odour-threshold level and irritation level for two of the most important emitted substances. The calculations thus show, given the stated conditions, that the risk of odour or irritation on account of the linseed-oil paint is very small, even where there is very little air exchange in the room or apartment (corresponding to natural draught ventilation).

Conditions	**Theoretical concentration ($\mu g/m^3$)**	
	Nonanal	***Formaldehyde***
Window material surface: 2 m^2 Air-exchange rate: 0.1 n/h Floor area: 60 m^2 Ceiling height: 2.4 m	0.69	<1.39
Window material surface: 2 m^2 Air-exchange rate: 0.5 n/h Floor area: 60 m^2 Ceiling height: 2.4 m	0.14	<0.28
Window material surface: 4 m^2 Air-exchange rate: 0.1 n/h Floor area: 100 m^2 Ceiling height: 2.8 m	0.71	<1.43
Window material surface: 4 m^2 Air-exchange rate: 0.5 n/h Floor area: 100 m^2 Ceiling height: 2.8 m	0.14	<0.29

Table 5 *Exposure during occupational use. The odour-threshold level for nonanal is 13 µg/m3 and irritation-threshold level for formaldehyde is 150* $\mu g/m^3$.

Figure 4 *Students at Bjäresjö School, Ystad learning how to use solvent-free linseed-oil paint manufactured by local raw flax material.*

Emulsion paint – on indoor and outdoor walls

In order to make a very resistant, matt wall paint for indoor and outdoor use, water can be added to linseed-oil paint. In our school in Ystad, built in the 1920s, we found the walls were easy to wash with water and very resistant to wear. This was a fairly gloss paint and very common in corridors, kitchens, and bathrooms.[21]

For many years our daughter has been painting walls using a range of modern paints, without really being satisfied with the end result. In recent years she has combined her work with wider studies including ecological product development. The idea of linseed-oil paint for painting interiors has grown apace with her environmental awareness and the demand for locally produced, renewable raw materials. Her dream has been to have access to a paint that can be applied like a modern, acrylic paint, looks like a limewash, and has the durability and diffusion characteristics of linseed-oil emulsion. Moreover, the paint should be able to fill surface imperfections and be washable. The environmental goal was to replace acrylic-based paints with a new product that fulfils environmental, fire, and safety demands.

Linseed-oil wax from Finland

Several years ago we visited Svartå Castle in Finland and learned how to treat wooden floors. In the eighteenth century floors were treated with casein glue and linseed oil mixed with beeswax. The wax was used as an outer protection on unpainted, varnished, or painted wooden surfaces. This gives an easy-to-use and environmentally friendly protection. First brush off loose pigment and clean the wood surface. Apply the wax with a plastic foam sponge and then polish the surface with a soft cloth.

Linseed-oil soap

Linseed-oil soap is made from cold-pressed raw linseed oil. In the early twentieth century, Dr Hector in Malmö wrote about the 'king among soaps': a clean glycerine soap made from linseed oil without additives.[22] We use this linseed-oil soap for cleaning brushes, floors, and benches, for spot removal, and for washing our hands.

Linseed-oil putty

Linseed-oil putty is manufactured from cold-pressed raw linseed oil and chalk. Various books record that this use was known long ago. Before the Second World War linseed-oil putty was used for many different purposes and in different forms: the puttying of windows, production of fillers, and as putty paste in the manufacture of lead glass. As long as windows were made of good-quality timber that was rich in resin, the linseed-oil putty could be applied directly on to unpainted surfaces. The linseed oil remained in the putty, giving a long life expectancy. We have found front putty that still has an inner core of soft linseed-oil putty after 100 years.

With the start of mass production in the 1960s, windows were made using fast-growing types of wood without any impregnation or resin. That is when problems started to arise. The oil in linseed-oil putty was quickly absorbed into the wood, so the putty hardened and fell away. This led to linseed-oil putty getting an undeservedly bad reputation.

When we started working on old windows in the early 1980s, we sometimes found traces of shellac solution as a protective layer underneath the putty. We now recommend that shellac is brushed into the putty groove before the glass is inserted. This prevents the oil seeping

Figure 5 *Liquid putty is brushed into small cracks in the front putty. This is a simple measure to delay ageing.*

into the wood. Our records show that the putty remains waterproof even after 20 years. Linseed-oil putty can be stored in a cool place. Old, hard linseed-oil putty can be refreshed in a few seconds in the microwave. The putty can be frozen for long-term storage. Knead the whole lump of putty until soft before use. It is easiest to apply putty at room temperature. The putty should be painted over, and is ready for painting immediately or the next day. A looser mixture can be obtained by adding a few drops of oil or turpentine to the putty and this can be used for temporary sealing of split putty grooves (Figure 5). Use a brush and wipe dry with paper after about 15 minutes. The surface can be painted over directly.

Conclusions

In the first part of this paper (March 2004), we described how we set out with a dream for the future. What started as a small private project 24 years ago has developed into a new profession – Windowcraft. Students from all over Europe come to our Windowcraft School in Ystad to learn how to maintain and restore old windows and doors using old-fashioned linseed-oil products. This is in accordance with general guidance on authenticity and conservation produced by the

International Council on Monuments and Sites (ICOMOS).[23] Since then, many jobs have been created, old and quality windows and doors have been saved for future generations, and environmentally friendly linseed-oil products have been used, fulfilling all the demands of Swedish[24] and European environmental laws. Thanks to our contact with universities and scientists, we have been able to complete our research with knowledge that was impossible for us to obtain as craftsmen.

We hope that our contribution in this paper will confirm the need for collaboration and make our vision come true – to create a society in which craftsmen, academics, and officials collaborate in mutual respect with the common goal of creating a sustainable, humane, and ecologically sound society, thereby supporting the creativity and skills of the individual.

Biography

Sonja Allbäck

Sonja Allbäck, born in Malmö, has a background as an economist and started her first company in 1969 within textiles. She studied ethnology at Lund University in 1977–78 and worked for four years at the regional arts and crafts museum in Sjöbo. Together with her husband, Hans Allbäck, she developed the new Windowcraft profession. She has been working since 1982 with documentation, product development, marketing, education, administration, and commercialization of their innovations. Since 1985 she has run a private school for building care and focuses on windows and doors, and from 1998 has also run Allbäck Linseed Oil Products Limited.

Hans Allbäck

Hans Allbäck, born in Gothenburg, has a background as a bank clerk and professional sailor. He was an apprentice carpenter in 1968–70 and started his own company to restore old houses in 1970. Hans was employed as a painter/decorator for several years and was also project leader at the regional arts and crafts museum in Sjöbo. He was employed for a year at the technical museum in Malmö, restoring old horse carriages. In 1982 he started the new Windowcraft profession with his wife Sonja Allbäck and has since been inventing tools and restoring thousands of old windows and doors in different European countries. From 1985 he has also worked as a teacher in his private international Allbäck Windowcraft School. Hans began working on linseed-oil research in 1982 and started to produce paints for his own projects. In 1998 he began to produce linseed-oil products for sale from Allbäck Linseed Oil Products Limited (www.linoljeproduklter.se).

Notes

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