Safe, Simple and Effective Cleaning of Shellac Coated Furniture
- are Tensides a Well Motivated Alternative?

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Abstract.
The aim of this report is to investigate whether there is one method for cleaning of shellac coated surfaces which could replace the other methods usually used in restorers/conservators workshops, a method which reaches up to a set of formulated standards concerning safety, efficiency and simplicity. Frequent use of organic solvents and materials with unknown, uninvestigated content constitutes a potential risk in a long term perspective, both for the worker and the object. If it is possible to replace these methods with one that is scientifically investigated, this must be seen as a better alternative. The range of different cleaning material has been looked into and from the set of standards one non-ionic tenside has been picked out for further investigation. Theoretically, non-ionic tensides is to be considered as more suitable for cleaning of shellac surfaces since they interact with the surface in a less harmful way than ionic tensides. From cleaning analysis it has shown that the non-ionic tenside Tinovetin® JUN gives pleasing cleaning results equivalent to the ordinary washing up liquid, “Fairy” (in Sweden known as “Yes”). However, from wetting ability analysis it shows that “Fairy” is more powerful. A contact angle analysis showed that Tinovetin® JUN leaves more residue than “Fairy” but the difference is not remarkable. Since washing up liquid contain ionic tensides, it is motivated to advocate Tinovetin® JUN preferably to “Fairy”.

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1. Introduction

The cleaning of objects in the world of conservation is a complex and multifaceted subject. It is one of the most commonly executed working processes but yet, in a theoretical sense, one of the most complicated. The criteria for a successful cleaning lies not only in the direct result, equally important is that the surface stays unaffected in a long term perspective. Substances which appear to be unaggressive may bind to the surface and, over time, degenerate it. Optimally one want to remove what is considered to be dirt and at the same time not make any damage on the underlying surface. How well this succeeds is depending on a number of parameters. The most important ones are:

- The dirt, its constitution and properties.
- The coating, its condition and chemical composition.
- The cleaning agent and the solvent in which it is dissolved, and their chemical properties.

When it comes to workshops connected to museums, universities and similar, those generally deal with cleaning a bit differently than private, small workshops. The first mentioned often have a number of different methods to work with and these are based upon scientific investigations. In general, the private, small workshops usually use fewer methods of a more practical character. A lot of their methods tend to be based upon subjectively inherited experience and knowledge. This must not necessarily be a problem, but if it is possible to use materials and methods whose effect and influence has been scientifically investigated that must be seen as a better alternative.

Many investigations in the subject of cleaning have been carried out. Through these, cleaning methods that include different substances and techniques depending on the character of the surface and dirt has been developed. Especially in the field of painting conservation, a lot of research has been made. It is possible to apply parts of this knowledge to the field of furniture conservation since both share common elements: both kinds of objects are often coated in a resin based material, paintings in varnish and furniture in shellac.

1:1 Aims of the project

This thesis was a try to take the science of cleaning shellac coated surfaces one step further. The main aim has been to investigate if there is a potential method/material for cleaning shellac coated surfaces which could replace the commonly used methods in small private conservation/restoration practices, one which reaches up to a set of demands concerning safety, efficiency and simplicity.

From looking into the different available materials used for cleaning, the tensides were designated. The aim was furthermore to investigate the motive to advocate use of tensides, and a certain type of them, taken the direct and indirect effects on the surface into consideration.
On the basic condition that the tenside cleaning reaches up to the demands formulated, the hope and intention is to interest furniture conservators/restorers in choosing this cleaning method (prior to the old methods used).

1:2 Methods
By formulating a set of criteria which could be considered to define what a good cleaning method is, one selection from the different cleaning methods was made. A questionnaire was sent out to eight workshops in order to get an understanding about how restorers/conservators work with cleaning and if there are any problems connected to it. Literature concerning cleaning in general and tensides in particular, has been studied. After choosing chemically pure tensides as a good candidate for replacing other cleaning techniques, two analyses were carried out. The first one gave indications about the cleaning efficiency in one chemically pure tenside contra one readymade tenside solution (washing up liquid, “Fairy”), commonly used in workshops. The second analysis could be seen as a complement to the first one, it indicated the wetting ability in the two chosen tensides, hence the tensides’ strength as a cleaning agent. In order to reach further conclusions, a contact angle analysis was carried out by the Institute for Surface Chemistry. This type of analysis gave information about the amount of tenside residue on a shellac surface after cleaning, giving indications about the safety of using tensides in a long term perspective.

1:3 Delimitations
Appliance of other cleaning agents besides tensides on a shellac surface would probably both have an impact and leave residue. However, within the frames of this work this has not been further investigated.

A number of investigations show that it is possible to decrease the amount of residue if the cleaning agent is used in a gel. It would be motivated to investigate this further, but since one of the criteria for cleaning, formulated in this work is “simplicity”, the choice has been taken to leave this matter aside.

Unfortunately it has been impossible to get hold of some of the key properties in the different tensides tested. It has anyhow been decided to carry on the investigations on basis a) The most important matter concerning the commercial tenside tested doesn’t specifically concern these properties. b) The chemically pure tenside is a non-ionic one; hence it is not really needed to know the exact values since it doesn’t exist any non-ionics with values considered to be “right”.

It is implementable to carry out several kinds of analysis useful for this work, but because of limitations concerning the facilities and economy this has not been possible.

The subject of tensides and cleaning include a great deal of chemistry, thereby the level very easily tend to become chemically advanced. This work does only deal with the chemistry just needed for understanding the entirety of the topic.
Due to the properties in shellac it has been very common to mix it with resins in order to make it stronger and harder, this has resulted in an endless variety of coatings. It would be a huge job to map out all the different kinds of mixtures and investigate them in the same manner as done in this work. Hence, the choice has been taken to focus only on pure shellac since it is the most common ingredient in these mixtures.

1:4 Critics of sources
There is quite a lot of investigations done and literature written on the subject cleaning, however these mainly concern oil paintings and varnishes, very little has been done on shellac surfaces. Due to the chemical similarities in shellac and varnish, a lot of this literature has been a useful base for this work. However, since having limited knowledge in chemistry, some parts of the literature created problems.

Since this work involved dealing with analysis and material ordinarily not occurring in conservation, it was problematic to locate persons who were able to answer questions concerning this.

The question form was sent out in an early state, before some modifications in the work were done, there could have been a more detailed focus on the specific subject. In addition, it would have been useful to ask a larger amount of workshops.

Due to the limited facilities of elaboration equipment, the types of analysis carried out were not completely exhaustive, more detailed answers would have been wished for. Furthermore, because of the weaknesses in the cleaning analysis, there was not really any point in testing more than one surface. There have nevertheless been problems with finding the right analysis methods which could give more straight answers.

2. Background

Cleaning of shellac coated furniture in workshops often include appliance of substances with unknown ingredients and uninvestigated effects, organic solvents of different kinds are also commonly used. In common for all the organic solvents is that they are more or less hazardous, by insufficient safety equipment and long term exposure there is an increased risk of health problems.

It would be fair to guess, from an efficient point of view, that the primary aim for many restorers/conservators when cleaning is the direct effect; the cleaning agent doing the most effective job is the one preferred. What happens with a surface on a chemical/microscopic level and in a long term perspective is subordinated. Even though there are no investigations showing accelerated degeneration from use of mentioned substances it is, from a theoretical perspective, likely that they have an effect. If it is possible to eliminate these potential risks by the use of a substance with investigated effects it would be a better alternative.
It is motivated to say that the commonly used cleaning methods in general follow along with good restoration ethics since they are used with the aim of keeping a coating instead of removing it. But adding the aspect of criteria formulated in this work, it is motivated to state that some of these methods are more or less unsuitable.

From the beginning of the 19th century up to the beginning of the 20th century, the most used coating on furniture has been shellac (pers. comm. Dr. Piening). Included in good restoration ethics is the use of authentic material, this means that originally shellac coated furniture are recoated in the same material. By knowing this, it is easy to understand that there is a great amount of shellac coated furniture passing in and out of workshops today. Since pure shellac is quite soft and sensitive to heat and moist, it often occurred as a blend with resins, e.g. dammar, mastics or copal. Without knowing the exact constitution of the surface it is difficult to know all about the properties in the surface, however, this work has been aimed on dealing with shellac. By knowing about the basic chemistry behind shellac it is easier to understand and choose the ways of treating it.

2:1 Definition of a shellac surface
Shellac is a product coming from the secretion of lice (*Lacifer lacca*) living on trees in India and the South East of Asia (1-4). The secretion is collected, refined, dried and sold as flakes. In order to use it as a coating, it is dissolved in ethanol. The finishing product can have different properties and colors depending on if it is bleached and the degree of purity. Different qualities are sold under a variety of commercial names, such as “super blonde”, “lemon” or “ruby”. The molecular structure is complex and contains thermoplastic mono- and polymers of carbonic acid, esters and a large amount of aleuritic acid. The groups of acids makes the molecule sensitive to alkaline substances. When aging, the alcohols oxidize into aldehydes and further to carboxylic acid, which gives the molecules polar, negative and even more acetic properties. The consequence of these processes is an increased sensitivity to polar solvents, such as water and ethanol, and to alkaline liquids which could make the shellac bind the liquid and swell. Furthermore the ageing of the shellac will also lead to cross linking, making them rigid and difficult to solve.

![Figure 1](image1.png)

*Figure 1.* Schematic illustration of aleuritic acid, the main component of shellac.
2:2 Definition of dirt
In order to deal with the problems of dirt, it is of value to know some things about the physics and chemistry behind it. In the air around us there small particles are constantly hovering: steam, textile fibers, dead skin cells as well as soot and fats from exhaustions (3). These impurities are also present on our body and our clothes in combination with salts and fats from our skin.

As long as an object is stored in the open air or come into physical contact, these particles will stick to the surface due to the impact of different forces: gravitation, intermolecular forces and electrostatic attraction (3, 5). The force of gravitation makes the particles land on non-vertical surfaces. Between all molecules, especially non polar ones, the Van der Waals forces are working. This is an intermolecular type of binding that occur when the electrons occasionally are asymmetrically divided, leading to an attraction between different substances. Another reason why dirt sticks to the surface is electrostatic attraction, occurring in both polar and non-polar substances. The attraction occurs in connection with mechanical activity, when two surfaces are rubbed against each other (e.g. when a cloth is dusting of a surface or a back is leaning against the lean of a chair). The reason for the phenomenon is the loss of electron from one substance to another. The force required to separate the atoms from each other in a molecule is depending on the type of binding and can be explained by the degree of cohesion (the binding force inside the molecule) versus the degree of the adhesion (the force between the different materials).

![Figure 2](image.png)

**Figure 2.** Schematic illustration of cohesion contra adhesion.

As mentioned earlier dirt is a mix of several different substances, salts which are polar, ionic compounds, and non-polar hydrocarbons such as particles from cotton, wool, skin cells, soot and fat. When the hydrocarbons are exposed to oxygen, especially in combination with light and heat, they become oxidized (3, 4, 6). The oxidation will change their properties and make them more polar. A layer of oxidized dirt on a surface can be understood as coated in a rigid shell when trying to remove it, the main reason for this is the strong covalent bindings formed by oxidation (see figure 3). Dirt fixed on a surface also has got hygroscopic properties; this is
due to the polar groups. This involves a risk to the object since the humidity is attracted and can lead to degradation.

**Figure 3.** Schematic illustration of oxidized dirt.

### 3. Cleaning of shellac surfaces

To formulate what a good cleaning method could be, a set of criteria which take both the object and the worker into consideration was set up;

**Safe:**
For the object: Does not solve, alter or scratch, leave a minimum of residue on the surface. Does not contain any unknown substances.
For the executer: Does not contain organic solvents or other harmful substances that requires breathing mask or draft cupboard. Does not contain any substances considered to be a health or environmental risk.

**Simple:**
Not complicated, difficult or time consuming to produce or execute. Does not require special or expensive equipment.

**Effective:**
Remove dirt from the surface without requiring a lot of mechanical activity. Does not consist of more than two treatments and not require long time of exposure.

#### 3:1 Questionnaire and result

In order to get an understanding about the work of cleaning shellac surfaces in workshops, and the problems possibly connected to it, a questionnaire was formulated. By looking at an overview of furniture restorers/conservators, the questions were sent out to eight workshops, four of them replied. Since there was no aim in investigating the relations between the ways of working and size/type of organization of the workshops, there were no other information about the workshops collected. The answers are presented in Appendix.
Questions;
1. How do you begin your cleaning of a surface, do you do any investigations or analysis?
2. What substances do you use, do you use different substances depending on the character of the surface?
3. Do you choose different substances depending on the type of dirt (fatty, dusty etc.)?
4. Do you experience problems connected to the cleaning of shellac surfaces? If so; which are the problems and how do you deal with them?
5. On what basis have you decided what technique to use?
6. Have you ever tried any methods or techniques that you no longer use? If so, which and why did you decide not to use them anymore?

Result
The answers in this investigation were quite diverse, some of the workshops seem to have a well developed and sophisticated system for cleaning, while others don’t. However, it seems as if all the workshops act with intention to spare the coating, rather than removing it. The amount of substances used is limited, the most commonly mentioned are different kinds of organic solvents, preferably Naphtha, and Centurio. The use of washing up liquid was only mentioned by one of the participants, but it is adequate to emphasize that the frequent use of this material is generally known. From my own experiences in four different workshops, the washing up liquid is a common cleaning agent. The participants didn’t experience any specific problems, the methods they use give a pleasing direct result. All the workshops seem to have a system in their way of working, based upon the knowledge collected from others. One participant mentioned knowledge that was collected during the study time. None of the workshops seem to have come across substances which, after reassessing, have been considered as inappropriate for different reasons. Only one workshop mentioned that they avoid substances with unknown content, such as readymade polishes.

3:2 Materials normally used in the field of conservation
In this chapter, a range of different methods/materials used for cleaning of objects is presented, along with the reasons which makes them less suitable according to the criteria set up.

Organic solvents: Organic solvents such as benzene and naphtha are commonly used for cleaning of shellac surfaces, although it is known that frequent exposure can cause health problems. By inhalation and absorption through the skin they may evoke skin problems and irritation. To people developing hypersensitivity or allergy, further exposure can be very difficult (7, 8). Since the appliance of shellac involves ethanol (organic solvent) one can never escape the organic solvents completely, but minimizing the exposure is a wise preventive measure. It occurs that conservators/restorers use breathing masks and gloves, but without sufficient ventilation, vapors will stay in the air after usage. In addition to this, investigations has shown that the organic solvents needs more time to evaporate than expected, meaning that
the solvent and its impurities will be absorbed into the coating and the material. When applying a new coat of shellac the impurities may get trapped inside. However, the exact meaning of this has not been further investigated. It is important to mention that probably all workshops, regardless size or type, use organic solvents.

**Washing up liquid:** The use of washing up liquid mixed with warm water is relatively common in workshops (the most common one is “Fairy/Yes”). Readymade products contain a mix of different types of tensides, catalytic and oxidizing substances, perfume, dyestuff and sometimes softener. With only the tensides actively cleaning the surface, the other substances constitute a potential problem or risk. Furthermore, in addition, the proportions of the different substances are often unknown (6). Use of readymade products can, on these terms, be considered an unnecessary risk.

**Centurio:** This is a substance made for polishing furniture and similar surfaces. Readymade products like these are common on the market under different names, however the most frequently occurring is Centurio. The label states that the content is a water/oil emulsion with abrasive mineral grains. When asking the producer (Bro Chemicals) for further information on the constituents, it was explained to be a secret with no plans on revealing. Because of the unknown content, it is motivated to classify it as an unsuitable cleaning agent. Furthermore, the abrasive grains makes it unsuitable for this type of use.

In workshops connected to universities, museums and similar institutions, the amount of cleaning methods is in general larger. There is no ground for saying that the people working there has got more knowledge, but often these kinds of workshops have better facilities than smaller private ones. In opposite to small workshops, the way of working often includes the developing of a cleaning system based upon analysis of dirt and surface, in these cleaning systems several methods and materials can be included. Here follows a range of common materials used:

**Buffer systems:** By making a buffer solution where the pH can be precisely adjusted it is possible to remove dirt from a surface (9, 10). However, in order to make these buffers, certain types of apparatus and chemicals are required. It may also take some time to adjust the pH to the right level; furthermore the use of acid and bases is connected with some safety requirements. Based upon this, the creating of a buffer system is considered to be too complicated and time consuming.

**Amino acids:** By choosing the right amino acid it is possible to clean a surface safe and effectively (6, 9). The only material used beside the amino acid is water, however the temperature and pH of the solution must be precisely set in order for the solution to be active. Working under these conditions is considered to be too complicated in a small, private workshop.

**Chelates:** For cleaning of “normal” dirt, this kind of substance is not commonly used. Chelates are in general made up from organic compounds and are mostly used for reduction
of corroded metal (9). Their ability to solve fats is limited and mainly they are used as suspension material in a cleaning system to keep the dirt in the solution.

**Dry cleaning:** A number of different dry cleaning products are available on the market; these can be considered safe as it doesn’t involve any liquids. However, there is a risk of rubbing alien material into the surface of the object (6), in addition it is time consuming and unpractical when it comes to large and complex surfaces.

**3:3 The chosen method - tensides**

**Tensides:** On basis of the criteria formulated, one method is initially preferred: chemically pure tensides. Thanks to its chemical properties it fills the primary purpose - removal of dirt. In addition, it doesn’t damage the surface, doesn’t contain unknown or volatile substances and it is not complicated or difficult to work with. There is an enormous amount of tensides on the market and only some of them are suitable for cleaning shellac surfaces. The following chapter will describe the main characteristics of tensides, the properties which are important regarding this topic, and the problems connected to the use of them.

**4. Tensides**

The word “tenside” comes from Latin and means “to clean”, it is a collective name for all products which possess the ability to clean. Common for all is that they consist of one hydrophilic (water loving) and one hydrophobic (water hating) part (11). The hydrophobic part consists of a chain of non-polar hydrocarbons and the hydrophilic part of a polar substance, the type is depending on the ionicity of the tenside. This will be more thoroughly discussed in coming chapters.

![Figure 4. Schematic illustration of a tenside.](image)
When it comes to determining tensides’ influence on the substrate, there are both properties in the tenside and the solution which plays an important role. The critical micelle concentration and hydrophilic/phobic number directly decides how the tenside interact with alien material. In addition, there is research made, showing that alteration of temperature, pH or concentration can affect the interaction between tenside and substrate. Hence, these factors are important to take into consideration when investigating the tensides’ suitability for cleaning different types of surfaces. As far as I know there have been no investigations on interaction between shellac and tensides, but Richard Wolbers give account of tests made on oil paintings and varnish in his book “Cleaning of painted surfaces”, he also refers to tests made on other hydrocarbon based material; these tests constitute the base for this chapter.

4:1 Physical and chemical properties in tensides
When adding a tenside to water the molecules will first distribute themselves along the surface with the polar ends pointed into the solution. When concentration rises and no free space is present along the surface, molecules will start to form spheres inside the bulk. The molecules arrange themselves with the non-polar ends pointed into the middle, as far away from the water as possible. Any non-polar substances present (e.g. dirt) will be captured inside the spheres.

The cleaning effect is based upon change in surface energy (surface tension) and adsorption (substance binding to surface) (10, 12). When adding a tenside to a bulk, the surface energy will be reduced, it will become more alike or lower than the surface energy of the material to be wetted, this allows the wetting to take place. After this has occurred the polar parts of the tenside can adsorb to the dirt and further, by mechanical action, loosen the dirt and transport it away.

4:2 Types of tensides
The synthetic tensides consists of a number of sub groups the main groups are presented here.

4:2:1 Anionic tensides
This type of tenside is in general the most commonly used and is considered as the most effective one (9,10). Its hydrophilic ends consists of different kinds of negatively charged salts, e.g. sulfates or carboxylates. Their ability of interacting with polar substances lies in their charge.

4:2:2 Cationic tensides
These are mostly used as softeners and their cleaning abilities are poor, hence this type will not be further discussed in this work (6).

4:2:3 Non-ionic tensides
The hydrophilic end of this type of tenside consists of a neutral group such as alcohol or glycol (pers. comm. Dr. Piening). The cleaning process of the non-ionics, work by evening out osmotic pressure differences. When the tenside stick to the dirt, water will come flowing
in, evening out the pressure, consequently the water will separate the dirt from the surface (12).

The non-ionic tensides have a unique property; at a certain temperature they precipitate, this is called the cloud point (6, 13). The cloud point varies between tensides, but is in general around 50 °C or more, when the temperature decrease the tenside will resolve in the solution again. In this case, this is not really a problem since a solution that hot would not be used anyway due to the increased risk of penetration through coating and wood.

4:3 Descriptions of tenside properties, solution conditions and their significance
Here follows an account of the chemical properties in tensides, the parameters concerning the solutions in which they are solved, and the importance of these.

4:3:1 Critical micelle concentration (CMC)
When reaching a certain concentration in a solution (mM), tenside spheres form, this is called the critical micelle concentration (6, 10-12). This value varies between tensides and is determined by its structure and charge. At the point when the spheres form, the dissolution and removal of dirt starts. High CMC indicate that the tenside has a more hydrophilic character rather than hydrophobic, the carbon chains in these are shorter and subordinated the hydrophilic groups. In order to get them to interact with each other and form micelles, a higher concentration is required (the problems concerning concentration will be further discussed in 4:3:5). Contrary, a low CMC comes from the polar groups being subordinated, the carbon chains are longer and the tensides preferably interact with each other and other non-polar groups. (pers. comm. Dr. Piening), hence they are good cleaners. Since shellac is a hydrocarbon based material (non-polar), the result of exposure to low CMC tensides (preferably non-ionic ones) would mean interaction to a greater extent than exposure to high CMC tensides (preferably anionic tensides). This is central problem concerning non-ions and will be discussed further in 4:4. In order to get a good cleaning effect within the safety limits of interaction, the recommendations by Richard Wolbers (in the book “Cleaning painted surfaces”) are above 2 mM but below 20 mM.

4:3:2 Hydro/Lipophilic balance number (HLB)
This value is a measure, made up by the industry to determine a tensides´ ability to form and stabilize an emulsion. (10-12, 14). This value is connected to the CMC and the properties that follows along with it, this is due to that the value of the CMC also is determined by the hydrophilility/hydrophobicity. The scale states the relation of the molecule weight in the hydrophilic and hydrophobic ends and reaches from 1-40. Lower values indicate a poor ability to form and stabilize emulsions, due to the tenside being more hydrophobic (or in some cases more hydrophilic), this is connected to a low (or if the tenside is more hydrophilic-high) CMC. If the tenside is too hydrophobic it will be difficult to dissolve in water. At a high HLB, interaction between the hydrophilic- and phobic groups is easily achieved, tensides with high values will have a middle value in the CMC range. According to Wolbers (in the book
“Cleaning painted surfaces”), the value recommended for cleaning of shellac surfaces is 18, in the book “Conservation of furniture” the number found is 13-20.

<table>
<thead>
<tr>
<th>CMC below 2</th>
<th>low HLB</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMC above 20</td>
<td>low HLB</td>
</tr>
<tr>
<td>CMC between 2 and 20</td>
<td>high HLB</td>
</tr>
</tbody>
</table>

**Figure 5.** Table showing the relation between CMC and HLB.

**4:3:3 pH in solution**

As mentioned earlier high pH constitute a risk to shellac surfaces as they may absorb the fluid and swell, or even dissolve (2, 10, 13, 14). Painting conservators sometimes use alkaline solutions to remove resin layers, indicating something about its powerful properties. By choosing an acidic solution (pH around 5) for cleaning an acidic/oxidized surface, conditions for a minimum of interaction between surface and solution is created. During the process of cleaning an oxidized surface, pH will go down as some interaction will take place. Taking into consideration that non-ionic tensides are independent of pH, it is motivated to state that they would be a better choice than anionic tensides in situations like these. Wolbers recommend pH 5-7 for cleaning shellac surfaces.

**Figure 6.** Plot showing the percentage of adsorption in relation to the increasing pH, in three different tensides solutions (10).
4:3:4 Temperature
The temperature of a solution will affect the pH, when increasing, the pH will lower (pers. comm. Dr. Rydell). Without using a buffer system it is possible to lower the pH slightly by warming the solution. This is of value since a pH on the lower range of the scale means less interaction with shellac. By increasing the temperature from cool to warm, it is also possible to speed up the chemical process taking place during cleaning.

![Figure 7](image.png)

**Figure 7.** Plot showing the difference in adsorption between one tenside solution of 0 °C and one of 30 °C. A represents the CMC point, B represents the maximum level (10).

4:3:5 Concentration
The relation between increased concentration and efficiency is not completely linear. When the CMC is reached, the decrease of surface tension stops and efficiency is theoretically at its maximum (6, 9, 10). It is important both for non-ionic and ionic tensides that the concentration is held above the CMC in order to retain the cleaning effect. If the concentration decreases below CMC, anionic tensides can form salts which are difficult to solve, this does not occur with non-ionic tensides. Those will, in contrast to anionics also keep dirt in the solution regardless of the concentration; however their cleaning abilities will decrease. During the absorption of dirt in the tenside molecules, the concentration of free tensides will automatically decrease. Due to this, concentration must be made up with a margin, Wolbers recommend 5 x CMC. An exaggerated dosage of tensides will, in general, lead to an increase in adsorption into the surface up to a certain point. There are no investigations made especially on shellac but tests carried out on cotton fabric confirm this statement. In “Cleaning painted surfaces” Richard Wolbers states that it is motivated to believe that the scenario is applicable on other materials as well as cotton.
4:4 Problems concerning tensides

When cleaning a surface with tensides, a certain amount will always remain on the surface (pers. comm. Martin Andersson, Institute for Surface Chemistry). It is partly due to the chemical properties in the tenside and the solution in which it is dissolved, which has been presented in the latter chapters.

However, it has also to do with the physical properties in the shellac layer itself. On a molecular level the shellac layer looks like a web where molecules can become trapped. In addition, a degenerated shellac surface is full of crackles and fractures, allowing tenside solution to move down by capillary action. This phenomenon constitutes a main problem with non-volatile fluids. When tensides are adsorbed, further degeneration will be supported: the hydrophobic group will connect with new non-polar material added to the surface; the hydrophilic groups will attract water and other polar substances. Hence the surface will more easily become dirty and in addition, hygroscopic. The hygrosopicity will lead to movement in the shellac layer due to changes in the air humidity. An old oxidized shellac surface is rather inflexible and thereby the movement may lead to further crackling. (Dr. Piening pers. comm.). It is of value to emphasize that this problem does not only concern cleaning with tensides and water. Due to the physical properties in the shellac layer, other kinds of substances applied, could get trapped as well.
Use of water based systems with either an anionic or non-ionic tenside is not a problem free choice, along follows a set of benefits and disadvantages. The main problem concern the way tensides interact (pers. comm. Dr. Piening). Anionic tensides contain salt groups, they are thereby inclined to react and bind with the hydroxide groups in the shellac molecule. This occurs even though the CMC is high. Salts are very hygroscopic; hence presence of those in the shellac layer will increase the hygroscopicity. In addition, the salts forming of crystals in a layer constitutes a risk of damage in the structure. The non-ionic tensides doesn’t react in the same way, since they don’t contain salt, instead the alcohol or glycol groups bind with the surface and these could work as solvents or softeners. However, both alcohols and glycol are volatile substances, meaning that they can evaporate from the surface, unlike salts. Since the non-ions have a low CMC they are more inclined to bind with the surface, in order to remove largest possible amount of tenside residue, a liquid that constitute a greater attraction than the surface has to be used.

Here follows an overview of pros and cons:

4:4:1 Disadvantages with anionic tensides:
- Anionic tensides leave salt on the surface, because of the strong hygroscopic properties in salts, this constitute a great risk to the surface (pers. comm. Dr. Piening).
- The precipitated salts form crystals in the surface, the forces occurring when this takes place, will damage the surface (pers. comm.: Dr. Piening).
- The pH at which they work best is 8 or higher (a pH elevated above 7 means a risk of swelling of the surface and thereby adsorption into the surface of the shellac) (13).
- If the pH is too low the forming of salts will increase (12).
- If the concentration is not constantly held above the CMC, the risk of forming of salts will increase (13).
- The presence of some types of oppositely charged ions in the bulk will depress the effect of the tenside (11,13).
- They can, in some cases, be too powerful or effective (11).

4:4:2 Advantages with anionic tensides:
- The CMC can be manipulated and tailored, by adding some types of counter ions in the bulk or mixing different tensides (6).
- They have a generally higher CMC and HLB than non ionic tensides (14).
- They are powerful and effective (6).

4:4:3 Disadvantages with non-ionics:
- The functional groups consist of alcohol or glycol, the residue from these can work as softeners or solvents on the surface (pers. comm. Dr. Piening)
- They have a lower CMC than the anionics, meaning that the removing of residue is more difficult and may require organic solvents (9).
- Their CMC cannot be manipulated or tailored.
- Their HLB is lower than the anionics.

4:4:4 Advantages with non-ionic tensides:
- The alcohol or glycol is able to evaporate from the surface without leaving it affected, in comparison to the salts from the anionic tensides (10, per.comm. Dr. Piening).
- Since they don’t contain any salts (any charged groups) the risk of reacting with oxidized groups of the shellac is small (pers. comm. Dr. Piening).
- Their efficiency is independent of pH (10).
- They don’t precipitate when concentration decreases below CMC.

4:4:5 The problematic concerning CMC, HLB and concentration are connected to each other and the relations can be presented in this way:

<table>
<thead>
<tr>
<th>Low CMC</th>
<th>Good effect even in low concentration</th>
<th>Give an unbalanced/low HLB</th>
<th>Low CMC and HLB constitute a risk of increased interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium CMC</td>
<td>Good effect without high concentration</td>
<td>Give a high HLB</td>
<td>Medium CMC constitute a decreased risk of interaction</td>
</tr>
<tr>
<td>High CMC</td>
<td>High concentrations are demanded to give good effect</td>
<td>Give an unbalanced/low HLB</td>
<td>High CMC and low HLB constitute a risk of increased interaction</td>
</tr>
</tbody>
</table>

Figure 9. Table showing the relations between CMC, HLB and concentration.

5. Analysis

It has not been easy to pick out the non-ionic tenside to test; there are a number of potential candidates. On recommendation from Dr. He inrich Piening at the Bayersisches Schlösserverwaltung, München, I have chosen Tinovetin® JUN. Dr. Piening has extensive knowledge on the subject and Tinovetin® JUN is commonly used for cleaning in the Schlösserverwaltung, not only by furniture conservators but also by textile and paintings conservators. This tenside is an aqueous preparation based on ethoxylated aliphatic alcohols (data safety sheet Tinovetin® JUN). The only hazard designation is irritation if it gets in contact with the eyes, hence no safety equipment is required (data safety sheet Tinovetin® JUN). The substance is mentioned in the literature but has never been subjected to more thorough investigations. Presently there is no information about the HLB and CMC values; it is however possible to determine the CMC by analysis (15), unfortunately this analysis was beyond the scope of this study. It can anyhow be assumed that the CMC lies in the lower part of the scale, just like other non-ionic tensides.
In order to determine if Tinovetin® JUN is worthy as a candidate for further testing it is important to estimate its cleansing capacity. This was done by comparing it with an equal substance used in workshops: “Fairy” washing up liquid. As mentioned earlier, the disadvantage with ready-made products is the unavailable information about chemical properties. I’ve been in contact with Proctor & Gamble in order to get information about CMC and HLB, but unfortunately those have never been measured. As this kind of information is irrelevant to the intended user, this is not unexpected or surprising.

Test cleanings with the two tensides were carried out in three degrees of concentration. I chose the recommended concentration and two stronger doses, in order to get a fuller picture of their effects.

5:1 Analysis 1
Aim: To investigate the cleaning effect of two chosen tensides and water on a shellac coated surface.
Analysis: Testing the cleaning effect of Fairy vs. Tinovetin® JUN on a shellac surface.
Background: The weakest concentrations in the analysis carried out was chosen on basis of recommendation from the producers. The other two solutions tested were x2 and x3, in order to investigate if there was any remarkable change in efficiency. Since the solutions were warmed, and the tensides in the solutions could affect the pH, a measuring of pH was carried out. According to [http://www.lenntech.com/Correlation-between-pH-and-Temperature.htm](http://www.lenntech.com/Correlation-between-pH-and-Temperature.htm), the pH at the temperature of 40ºC (the temperature of solution used in the tests), would be 6.77, this correlated well with the measured values. According to a test carried out with an anionic tenside on cotton presented in the book “Cleaning painted surfaces” there is a decrease in adsorption when the temperature is increased from 0ºC to 30 ºC. It was thereby motivated to use a warm tenside solution. In addition, an increase in the temperature would facilitate the solving of dirt.

Materiel:
- A piece of dirty, old veneer seemingly coated in shellac
- “Fairy” washing up liquid (content according to the label: 15-30% anionic tensides, 5-15% non-ionic tensides, Methylisothiazolinone (preservative), Phenoxyethanol (preservative), perfume, limonene (citrus perfume)).
- Tinovetin® JUN (Aqueous preparation based on ethoxylated aliphatic alcohols, Source: Kremer Pigments).

<table>
<thead>
<tr>
<th>Particle board</th>
<th>pH meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish glue</td>
<td>UV lamp</td>
</tr>
<tr>
<td>Tap water</td>
<td>Hot plate</td>
</tr>
<tr>
<td>Test tubes</td>
<td>Cotton and a bamboo stick</td>
</tr>
<tr>
<td>Pipettes</td>
<td>Flask</td>
</tr>
</tbody>
</table>
Execution:

1. The veneer was glued to the particle board with fish glue.
2. The surface was investigated macroscopically and in UV light, judging if the surface looked fatty or dusty, the constitution of the dirt was estimated. The glow of the surface was estimated in UV light, in order to be compared with the glow after cleaning.
3. 6x2 test squares (1.5 x 1.5 cm) were marked out in the upper region of the piece. This area was chosen because the chance of finding fatty dirt here was the best. Two extra squares were made for water.
4. Each tenside was prepared in three different concentrations, in order to investigate a possible difference in effect between different tensides. The weakest one was the recommended dose and the other two: x2 and x3.
5. The pH in the different solutions was measured with pH meter (Mettler Toledo).
6. The tenside solutions (and the water) were heated up to 40º C, a temperature that can be considered as lukewarm.
7. Cotton was wrapped around bamboo sticks to a small q-tips, and one by one the q-tips were dipped in tenside solution and slightly dried off on clean cotton fabric. Finally they were rolled over the square eight times.
8. The result of the cleaning was investigated macroscopically and utilizing UV-light. During the macroscopic analysis a judgment of the amount of dirt removed by the solution, both by looking at the surface and the q-tip. In UV light, an eventual change in the brightness of the glow of the surface was studied. The reason behind this investigation was that shellac fluorescence under UV and dirt in general, don’t. Hence it would be possible to see a brightening in the glow after the removal of dirt.
9. The change in the surface and the amount of dirt on the q-tip was estimated from 1 (no cleaning effect/no dirt sticks to the q-tip) to 5 (very good cleaning effect/a lot of dirt sticks to the q-tip). It is important to note that the marks on the q-tips were set in relation to the macroscopically judged amount of dirt on the surface.
Figure 10. Showing cleaning results in UV light.

Figure 11. Showing the cleaning effect in raking light.
Figure 12. Showing the cleaning effect in raking light.

Recommended concentration of “Fairy”: 2 ml/5 liters of water (Source: Proctor & Gamble). Recommended concentration of “Tinovetin® JUN”: 0.1-0.5 g/l of water (Source: Kremer Pigments). Since the density of “Tinovetin® JUN” is the same as water it was chosen to prepare the two solutions in the same concentrations.

Solutions, concentration:
1. Tinovetin JUN 0.4ml/l
2. Tinovetin JUN 0.8ml/l
3. Tinovetin JUN 1.2ml/l
4. Fairy 0.4ml/l
5. Fairy 0.8ml/l
6. Fairy 1.2ml/l
7. Tap water
Figure 13. Photographs illustrating the dirty veneer (A), the q-tips after cleaning (B), the result of round one in raking light (C), the result of round two in raking light (D).

(poor cleaning effect) – 5 (very good cleaning effect)

First round:

<table>
<thead>
<tr>
<th>Solution no.</th>
<th>Result, surface</th>
<th>Result, q-tip</th>
<th>pH-value (40ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>4</td>
<td>4</td>
<td>6.94</td>
</tr>
<tr>
<td>2.</td>
<td>5</td>
<td>5</td>
<td>6.91</td>
</tr>
<tr>
<td>3.</td>
<td>5</td>
<td>5</td>
<td>6.88</td>
</tr>
<tr>
<td>4.</td>
<td>5</td>
<td>4</td>
<td>6.91</td>
</tr>
<tr>
<td>5.</td>
<td>4</td>
<td>4</td>
<td>6.87</td>
</tr>
<tr>
<td>6.</td>
<td>3</td>
<td>3</td>
<td>6.66</td>
</tr>
<tr>
<td>7.</td>
<td>2</td>
<td>2</td>
<td>6.89</td>
</tr>
</tbody>
</table>

Commentary: 1-3 looks shinier than 4-6
**Second round:**

<table>
<thead>
<tr>
<th>Solution no.</th>
<th>Result, surface</th>
<th>Result, q-tip</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>4</td>
<td>4</td>
<td>6.94</td>
</tr>
<tr>
<td>2.</td>
<td>4</td>
<td>4</td>
<td>6.91</td>
</tr>
<tr>
<td>3.</td>
<td>5</td>
<td>4</td>
<td>6.88</td>
</tr>
<tr>
<td>4.</td>
<td>5</td>
<td>4</td>
<td>6.91</td>
</tr>
<tr>
<td>5.</td>
<td>5</td>
<td>5</td>
<td>6.87</td>
</tr>
<tr>
<td>6.</td>
<td>5</td>
<td>5</td>
<td>6.66</td>
</tr>
</tbody>
</table>

*Commentary: 3-6 look shinier than 1-3*

An analysis of this simple character has got its weaknesses:

- It is not possible to determine the constitution and amount of dirt, or the distribution of it. In order to reduce the risk of misjudgment there were two test rounds carried out in different areas.
- As the condition and constitution of the surface is impossible to investigate without having the right equipment, this could affect the result when it comes to judging the solubility/toughness. There were however no macroscopic signs of the surface solving or breaking up.
- Since information about the water content of the two tested tensides is not available, it is not possible to know if one is more concentrated than the other.
- The cleaning action was carried out by a human hand, hence all the rolling were not made with the same pressure and pace.
- A scale of marks is always subjective, but the marks were set in consultation with two others involved (Satsuki Nudeshima, Cecilia Nolin, students at the furniture conservation program, Carl Malmsten, Furniture Studies).

By the actions taken I consider myself getting around the factors of insecurity well enough to see my results as defendable.

**Result:** When investigating both macroscopically and in UV light, the two test rounds showed that the cleaning effect between the two different tensides tested, weren’t very striking. There was neither any remarkable difference in between the various concentrations. However, solution no 6 in the first test round showed a deviant result. Only when looking at the surfaces in raking light it was possible to see the different nuances in the effects.

**5:2 Analysis 2**

This is a simplified variant of a contact angle analysis. The latter mentioned analysis is done by measuring the angle of a drop on a surface, indicating the wetting ability, hence the efficiency.

**Aim:** To investigate how drops of a tenside solution looks on a fatty/dirty shellac surface in order to get an indication about the cleaning abilities.

**Analysis:** The wetting abilities in tenside solutions on a dirty shellac surface.
Background: When applying a drop of polar liquid (e.g. water) on a non-polar surface (e.g. shellac), the wetting ability will be poor, this will be manifested by a high, evenly round drop. The reason for this is the difference in polarity and the surface tension. By adding a tenside to the liquid, interaction between liquid and surface will be facilitated and the surface tension will decrease, this is shown by the flowing out of a drop. Both of these two factors will improve the wetting ability, the grade of improvement is depending on how powerful the tenside is.

Material:
A veneered wooden piece coated in shellac
A thick mixture of cooking oil and dirt taken from a window ledge in the inner city region
Tenside solutions (the same as used in the latter analysis)
Tap water
 Pipettes

Execution:
1. The mix of dirt was applied to the surface in a thin layer with a cotton cloth, and left to settle for one hour.
2. One drop of each of the solutions and the water were placed on the horizontally oriented surface.
3. The height and the flowing out of the drops were ocular judged from about 30 degree angle. Marks between 1 (very poor wetting ability) to 5 (very good wetting ability) were set in order to judge the wetting ability (the flowing out of the drop) of each solution. The drop of water represented mark 1, since it is known that the wetting ability of water on an oily surface is very poor. The appearance of the border between drop and surface was described.

Ranking of drops from 1 (the highest, most evenly round) to 7 (the lowest, most unevenly round).

Immediately after applying of the drop

<table>
<thead>
<tr>
<th>Solution no.</th>
<th>Height on drop</th>
<th>Appearance drop-surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>3</td>
<td>Almost evenly round</td>
</tr>
<tr>
<td>2.</td>
<td>2</td>
<td>Almost evenly round</td>
</tr>
<tr>
<td>3.</td>
<td>4</td>
<td>Almost evenly round</td>
</tr>
<tr>
<td>4.</td>
<td>6</td>
<td>Uneven, scattered</td>
</tr>
<tr>
<td>5.</td>
<td>5</td>
<td>More uneven and scattered than no. 4</td>
</tr>
<tr>
<td>6.</td>
<td>7</td>
<td>Most uneven and scattered</td>
</tr>
<tr>
<td>7.</td>
<td>1</td>
<td>Evenly round</td>
</tr>
</tbody>
</table>
Figure 14. Photographs illustrating the artificially made dirt (A), the drops from above (B), the drops from the side (C) and the drops from a 30 degree angle (D).

Just like the latter, this method has got weaknesses:
- The drop is placed by a human hand, meaning that the amount of fluid and the way it was placed differs from time to time. This could potentially distort the appearance of the drop.
- A scale of marks is always subjective, but the marks were set in consultation with two others involved (Satsuki Nudeshima, Cecilia Nolin, students at the furniture conservation program, Carl Malmsten, Furniture Studies).

Result: It was clear that there was a difference in between the two tenside types according to the wetting ability, the wetting effect of “Fairy” was stronger than of Tinovetin® JUN. There were also differences between the concentrations, the higher the concentration, the better wetting ability. This was most apparent in the “Fairy” solutions. This correlates well with the knowledge about “Fairy” containing both anionic and non-ionic tensides, the anionic ones are generally more powerful than the non-ionics. No 2 and 5 deviated, this could be due to the way the drops were placed on the surface.
5:3 Preparation for Contact angle analysis.
Aim: To investigate and compare the amount of residue left on a shellac surface from “Fairy” contra Tinovetin® JUN.
Analysis: Measuring of the contact angle between a shellac surface, earlier cleaned with a tenside solution and a drop of water.
Background: In order to determine the wetting effect of a solution on a surface; giving information about the degree of hydrophility/hydrophobicity, a contact angle analysis can be implemented (pers. comm. Martin Andersson). Tenside residue will give the surface an increased wetting ability, the more residue left on the surface the better wetting ability. This will be manifested when placing a drop of water onto a surface earlier treated with a tenside solution, compared to an untreated surface, the more residue the wider angle between drop and surface (see figure 15). This type of contact angle analysis is called *static contact angle analysis*. Since it was not within the frames of this work to carry out an analysis of such kind on the school, this task was managed by *the Institute for Surface Chemistry*. However the preparations were made before sending the samples to the institute.

![Contact angle analysis diagram](image)

*Figure 15. Schematic illustration of contact angle analysis.*

**Material:**
Three squares of veneered particle board (3x3 cm) coated in shellac
Two different tenside solutions (from “Fairy” and Tinovetin® JUN, both in recommended concentrations)
Cotton wool
Pipettes
Tap water
Execution:
1. Three drops of the different tenside solutions were placed onto the first and the second test squares.
2. A piece of cotton wool was moistened in tap water and then thoroughly squeezed.
3. The test squares were dried of in 5 swipes with the moistened cotton.
4. Three new cotton wool pieces were moistened, following the same procedure as the latter.
5. The third square was swiped two times with one of the moistened cotton pieces.
6. In two swipes, the two other test surfaces were dried of with the cotton, all the squares were left to dry for one hour.
7. The test squares were packaged in tin foil and sent to the Institute for Surface Chemistry.

The reason for packing the pieces in tin foil is that polymeric materials can have an effect on the analysis.

Figure 16. Diagram showing the contact angle in water on a shellac surface after treating it with tenside solution.
Result: The figures in the vertical column is showing the degrees of the angle. No 3: water gives a point zero and compared to that, it is clear that the surfaces treated with both “Yes/Fairy” and Tinovetin® JUN have got an increased wetting ability. The differences are not significant but yet clear; Tinovetin® JUN leaves more residue than “Fairy”.

6. Conclusions/Discussion

The subject dirt and cleaning is in many regards a complicated matter. In a practical context this is not always obvious since the furniture conservators/restorers use methods and materials that fills the purpose by showing immediate results. But by looking at cleaning in a more theoretical perspective one realize that applying of alien substances result in chemical and microscopic traces on the surface (e.g. the chemical effect of organic solvents, which is very briefly discussed in this work). Which meaning these traces have when it comes to the continued condition of the coating is not always known or investigated.

A tenside always leaves residue, it is impossible to avoid, this goes for both non-ionics and ionics. However, non-ionics are many times considered as a better alternative, not because they interact less (which they don’t) but because the result of their interaction is seen as being less harmful. It is still of great value to minimize the amount of residue, regardless the type of tenside, they all contain hydrophilic groups which attract water and hydrophobic groups which make fatty dirt stick.

It could seem odd that the method advocated in this work has got these kinds of disadvantages, but from the intention with this work, I find it defendable. From the criteria I’ve formulated concerning safety, simplicity and efficiency, cleaning with a chemically pure tenside can be seen as a potential replacement to other methods. Tensides with the “right” properties are easy to work with. They are solved in water and is, in a general and direct perspective, harmless to the object, the worker and the environment.

The written information concerning tenside cleaning can appear puzzling, non-ionic tensides are promoted and, at the same time a medium CMC which none of those can reach up to. The most ideal would thereby be a non-ionic with a CMC in the medium range, but since these don’t exist one is placed at a crossroad: less amount of harmful residue with an anionic tenside or a larger amount of less harmful residue with a non-ionic tenside. On basis of the information collected during this work I have chosen to follow the non-ionic path. There is of course a possibility that anionic tensides could show the same or better results in the analysis carried out, but trying out both was beyond the scope of this study. What makes the conditions for this investigation further more complicated is the avoidance of organic solvents, since a non-ionic tenside is preferably removed with one such. In this case it is a question of prioritizing different risk factors:
- Avoidance of organic solvents because they constitute a potential risk for the worker.
- The potential risk for the surface from increased residue of non-ionic tensides, when refraining organic solvents.

I took the decision to prioritize the avoidance of organic solvents, mainly because of their known side effects. The work as a restorer/conservator involves this kind of substances in many other working situations anyway. It would nevertheless be interesting to compare the amount of residue from one surface which have been after cleaned with organic solvent and one which have been after cleaned with water.

The questionnaire was carried out in order to identify the methods and materials most commonly used, and if there are any problems connected to these. Drawing too many conclusions from a very small poll like this one is dangerous, especially since many of the answers were not very exhaustive. It showed that none of the workshops experienced any problems in connection with cleaning. In correlation with my expectations, it showed that the most commonly used materials were Centurio and organic solvents (e.g. naphtha and benzene). There are no investigations proving these substances to be harmful to a shellac coating and since shellac endure many non-polar organic solvents, these could be an adequate choice. On the other hand, cleaning an object should not be done on expense of the health of the executer. It would be interesting to know if any of the participants use safety equipment when working with organic solvents, or if they have experienced any health problems connected to the use. Centurio is considered as harmless to the user, however, this substance falls under the criteria “unknown content”, appliance of unknown material must be seen as a doubtful alternative.

Surprisingly, only one of the participants mentioned washing up liquid, from my own experience this is a very commonly used material in workshops. It would be interesting to know if the concentration of washing up liquid solution is measured when prepared, on basis of my experiences, I suspect that solutions like these are arbitrary made up. This would potentially mean an over dosage since the recommended concentration contain a surprisingly small amount of cleaning agent. Even though the recommended concentration is not based upon cleaning of shellac surfaces, it would be fair to believe that solutions made up in workshops in general are too concentrated, meaning risk of increased residue.

When it comes to the analysis carried out, all of the cleaned test surfaces came out very similar, there were none of the test surfaces that were superior the others. In addition the mark on the “Fairy” solution of the highest concentration in the first round was surprising since it was poorer than the others. A possible explanation is the constitution of the dirt; it seemed to be fattier than the other test areas. While the surfaces tested in the second round were less dirty the result was a bit more difficult to determine. This is also reflected in the amount of dirt on the q-tips. The effect of water was unambiguous and expected, it was not as effective as the tenside solutions, the q-tips were as good as clean. The reason for the shininess of the
surface after cleaning was probably due to that the shellac layer in those regions was more intact. The good cleaning effect of “Fairy” was expected since it is a substance designed for dealing with fat and dirt, containing anionic tensides. However according to this analysis, it can also be stated that Tinovetin® JUN solve and remove dirt to a sufficient extent.

The wetting ability of the different solutions contributed with interesting information concerning the different solutions’ efficiency, it became clear that there is a difference in the power between “Fairy” and Tinovetin® JUN. Also differences between the concentrations were manifested. The applying of a drop of water in order to get a calibration point, made it possible to judge the result more easily. It was not very surprising that the wetting ability in “Fairy” was stronger. There was however deviance in drop no 2 and 5, probably due to the manner these were placed at the surface.

The implications from this work is partly inconclusive, it doesn’t say anything about how dangerous residue from a non-ionic tenside is compared to an ionic one, hence it is not motivated to state the non-ionic tensides to be the altogether perfect general solution for cleaning. Instead of promoting tensides, an alternative could be to advocate the use of safety equipment when using organic solvents, rather than avoidance of them. On the other hand, it is well motivated to investigate the effects of non-ionic tensides compared to washing up liquid, washing up liquid is despite commonly used without the effects being known or investigated. Since the residue amount from other materials is not investigated, it is difficult to say how well suited tensides are compared to these.

Despite the weaknesses concerning the simple character of the first two analysis carried out, I find it justified to state that Tinovetin® JUN has got an efficient cleaning effect. However, the contact angle analysis showed that this substance leaves more residue on the surface than “Fairy”. Since “Fairy” contain a large amount of anionic tensides it was not remarkably surprising, but because there are no data concerning CMC and HLB on neither of the substances, this was an informative discovery. If one want to follow along with the thesis “more, but less dangerous residue” it is defendable to continue the promotion of Tinovetin® JUN. But if taking the increase of hygroscopicity that follows along, into consideration, there is a possibility that this may not be the best path to choose. Nevertheless, the difference in amount of residue was not remarkably big, making me more inclined to stick with the believe that non-ionic tensides would be a better choice preferably to “Fairy”. It is important to note that it doesn’t exist a scale on what could be considered as a large or small amount of residue. This makes it difficult to put the results from the contact analysis into a wider perspective.

The conclusion from this investigation is that tensides is a more simple and easy alternative than many other methods, it is also more safe than the organic solvents. It is not unambiguously clear that non-ionic tensides are to be preferred, however the properties in the non-ions makes them theoretically more suitable. When focusing on the safety of the shellac coating in particular, this work is not exhaustive enough to be able to state tenside cleaning as a number one alternative.
Dictionary

Adsorb  A surface absorbing a substance  
Cleaning system  A cleaning concept created and tailored for a certain object  
Detergent  Synthetically produced soap  
mM  Millimol/liter  
Raking light  The light falling on a surface in a narrow angle  
Soap  Naturally produced tenside  
Substrate  Surface  
Tenside  Surfactant (surface active agent)-wetting agent

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Personal Communication

PhD Heinrich Piening, Bayersisches Schlösserverwaltung, München (08.04.09 & 12.04.09)
Chemist Martin Andersson, Institute for Surface Chemistry, Stockholm (28.03.09)
PhD Kristina Rydell, University of Lund (01.03.09-17.05.09)

Figures and illustrations

1. Schematic illustration of aleuritic acid, the main component in shellac (source Wikipedia)
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13. Photos illustrating analysis 1 (photographed by the author)
14. Photos illustrating analysis 2 (photographed by the author)
15. Schematic illustration of contact angle analysis (made by the author)
16. Diagram showing the contact angle in water on a shellac surface after treating it with tenside solution (made by the Institute for Surface Chemistry).
Appendix

Questionnaire

1. How do you begin your work with cleaning of a surface, do you do any investigations or similar?
   a.) It depends a lot on the character of the work. A surface which have been tested previously are not tested further.
   b.) Yes, we always carry out tests.
   c.) No
   d.) We always start with the mildest substance: Centurio. Careful cleaning with soap water and then immediate drying off. If this doesn’t help we clean with ethanol on paper or steel wool.

2. Do you use different substances depending on the character of the surface?
   a.) We don’t work very much with cellulose coatings, but we would do the same with both shellac and cellulose.
   b.) It depends more on the condition of the surface rather than the type of coating.
   c.) No.
   d.) Not really.

3. Do you choose different substances depending on the type of dirt (fatty, dusty etc.)?
   a.) Yes
   b.) It depends from case to case, but we dust of the surface and fat is removed with fat solving substances or mechanically.
   c.) No.
   d.) Dusting off with a moist cloth. Mark from shoes are removed with naphtha. Paint marks are removed with a knife. Centurio is often working well.

4. Do you experience any problems connected to cleaning of shellac surfaces? If so; which are the problems and how do you deal with them?
   a.) If we do experience problems, we try different known substances.
   b.) Not really. If the dirt has gone down into the surface it is problematic, but then you maybe have to accept the damage.
   c.) No.
   d.) Opaque coatings are washed with ethanol and steel wool until they are transparent.

5. On what basis have you decided what techniques to use?
   a.) Mostly through other peoples experiences.
   b.) Through trial and error together with other peoples knowledge that we learned about during our study time.
   c.) Naphtha and Centurio.
   d.) Through the trying of different methods during the years.
6. Have you tried substances or methods that you no longer use? If so; Which and why do you no longer use them?
   a.) No.
   b.) We mostly use Centurio, ethanol, naphtha or water. These are well tried substances, they are also simple and effective.
   c.) No, not that we can remember.
   d.) No.
   e.) We avoid polish with an unknown content.