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Choosing the procedure for repair of damaged arm at an unicate desk lamp

ABSTRACT

Repair of any unicate artefact always requires the challenge and however demands for high level of knowledge&experience in this field, at the same level conservation works. Those demands are regarding not only on visual appearance, it is itended to stain unchainched other properties, even to question of strength, either it is an artistic piece, also the possibility of lowering the corrosion resistance, after the repair works have done.

Here in details are analysed possible solutions for repairing of one broken arm when an unicate lamp unintentionaly is damaged. The used bulk material of the lamp is not available for using a kind of welding or soldering procedures, firstly that those methods will markably change the surface properties of the repaired zone. So, the repairing is provided by combining two methods: reinforcing with semihard aluminum wire and two component glue.

Keywords: *damage analysis, repairing methods, renforcing, sticking of broken parts*

1. INTRODUCTION

The subject of repair here is one unicate table lamp which is accidentaly damaged, exactly after one arm is broken. As the same lamp earlier was analysed [1] including the X–ray exmination, at the damaging place there were no found any irregularities which could responsible for such breaking.

The table lamp, however, has a common function, without a kind of heavy loading or simmilar service conditions, but to its owner this lamp has a particular importnace from the origin, it is dated from the end of XIX century, as the property of his family. The entire appearance of this lamp, registered before damaging, is shown in Fig. 1, at two views. The body of the lamp is produced by casting, after that is polished. The surface of this lamp is fully decorative protected. brown color originated from a thin copper coating. In the moment of deposition the coating, either it is provided in chemical or electrochemical process,the color might be adjasted by proper chemical contest of used electrolytes.

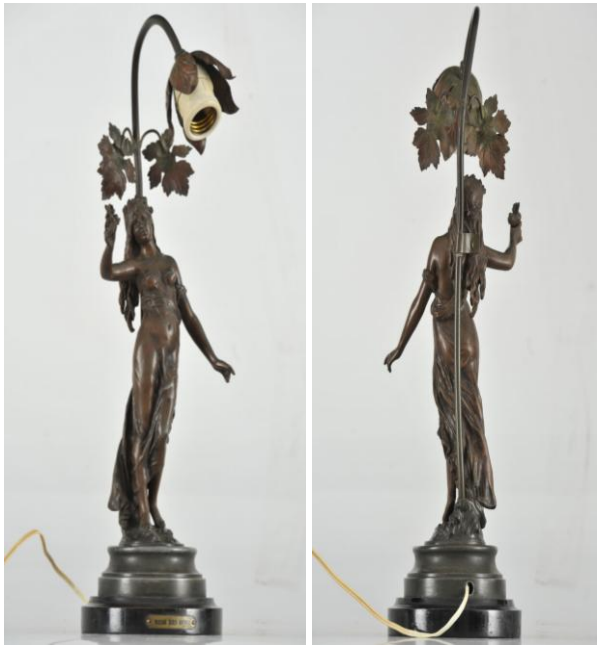

Figure 1. Two views of lamp statue before the arm is broken

Slika 1. Dva pogleda na statuu lampe pre nego je slomljena ruka

After the coating was deposited than the entire surface is lacquered with unvisible lacquer, as an usual procedure in decoration of such products.

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The whole lamp has no great dimensions, its hight is less than 300mm.

For repairing of this lamp is neccessary to aply a kind of acceptable solution, always keeping in mind that this subject was produced before arround 150 years. Every solution to be applied in repairing must posses the same (even greater) strength than the original piece, the same color at the repaired zone as the entire body of lamp, including the corrosion resistance in future, it meand after the repairing works is finnished.

2. MATERIAL OF LAMP BODY

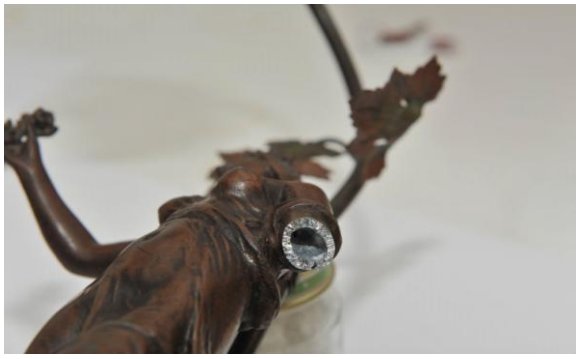
The table lamp was in the shape of women´s body, and is produced from an alloy of zinc and aluminum (in relation 95:5), finally copper platted and than lacquered. Chosen material belongs to alloys which in the moment of pouring into the mould cavity, posses high fluidity but low viscosityof molten metal. Those properties are just needed during the casting process of irregular shapes with many curvature lines, holes (including a bottom holes), sharp angles, most of them could be found in common artistic pieces made from a metal [2-7]. The chosen alloy further is corrosion resistant material, what represents one more advantage.

Condition of damaged lamp

The lamp is damaged at the left side of statue, exactly on the arm near elbow but just over this place, see Fig. 2a). At this place the arm from the lamp was hollow, Fig. 2b).

a)

b)



c)

Figure 2. Broken arm in two views a) and b); look at the lamp from downside c)

Slika 2. Polomljena ruka u dva pogleda a) i b) pogled na lampu sa donje strane

The inner diameter of hollow at broken arm was about 10mm, with wall thickness about 2mm. The depth of this hollow part was about 45mm. At the broken wall could be seen the great dendritic grains which is characteristics for as-cast structure of used alloy, see figs. 2b) and c). The hollow arm indicates that the lamp body is produced from various components which are first casted and than connected either by welding or brazing.

At damaged surfaces were not registered any deffects originated from a casting periode, as like shrinkage, slag or non-metallic inclusions, which generally may appeared in as-cast structure, no matter what kind of alloy is used. Generally, as-cast structure is a brittle.

The first step in every repair procedure is to assemble the damaged arm to the lamp body. After damaged surfaces were put together, it could be seen that there were no remarkable clearance, because a part of material is crushed but no lost, which commonly is a real case in damaging. Near the damaged surfaces were not found visible deformations on walls arround the arm and the body lamp, so such statement is resonable because the used material (with dendritic structure) has pretty low plasticity, i.e. the material is brittle.

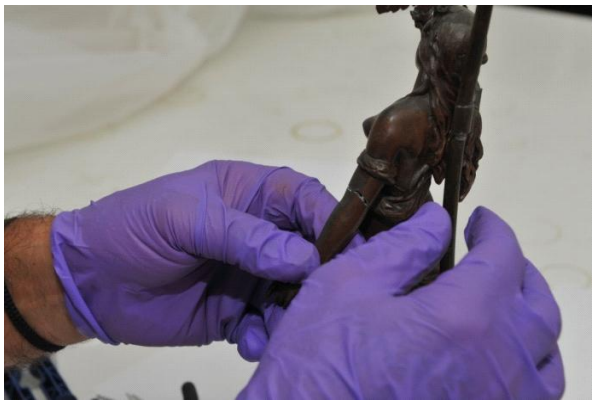


Figure 3. Two views of preliminary assembling of damged arm to lamp body

Slika 3. Dva pogleda preliminarnog sklapanja polomljene ruke za telo lampe

The preliminary assembling of damaged arm to the body lamp is shown in Fig. 3. This assembling has confirmed that there is no missing material, what represents a favorable condition in this case. If in contrast, the some piece of material is missing on assembling surfaces that the using of some filler metal will be obvious. But, the choosing and than using of a proper filler metal similar to the parrent metal of body lamp, and further its surface regeneration to the original appearance of this unicate piece, will be pretty complex job. It is clear that the achieving the same color of filler metal hardly will be find, may be the whole lamp should be copper plated and lacquered.

Choosing the procedure for repair

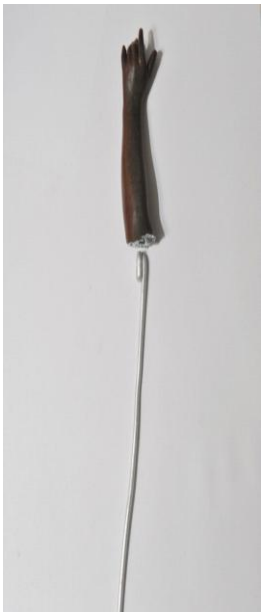
The rapairing of such damaged piece is achievable on several ways. At the first approach for joining of these components is possible by using welding or brazing [8-10], but those solutions were abandoned. It is well known that in mentioned processesthe relatively great amount of heat should be realized, but this heat no doubt will be change the color arround the joining zone, and such change is simply unacceptable in repairing of this unucate piece, as in some similar cases [11]. On the basis of autor´s experience the next four possible procedures were analyzed.

The first method might be a fullfillingthe entire cavity/gap by using two component glue, both at broken armand the hollow at the body lamp. But, at the beggining of discuss, the shrinkage percentage whenglue is used was not known: it referseither on bubling/expanding or intensive contraction. Both physical processes may have lead to the new damage of the arm or a body lamp, with creation a high level of stress, neither tensile or compresive. So, this plan of repair is canceled.

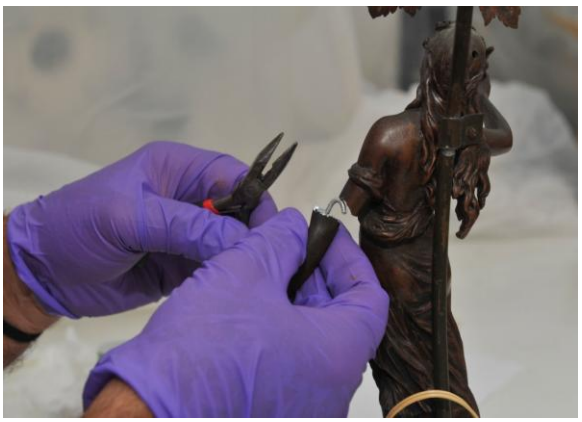
Second plan was to mix two components: glue with fine alumina powder (Al_2O_3), for example in granulation scale about 2-5μm or similar, and fullfilling the entire gap. The role of alumina powder, as expected, is to stregthen the glue matrix. But, there is posibility that the white alumina could be visible at the joining zone, and from that reason the second plan also is canceled.

As the third possible way of repairing is considered on reinforcing of glue by inserting an aluminum wire, according to Fig. 4a). It is well known that the aluminum is an innert material in regard to parrent material, it is an alloy made of zinc and aluminum, and from that point of view there is no dangerous for corrosion appearance betwen those materials. But, the limiting factor in this solution is the uncertaintyof such “construction”, because it was impossible to fasten the aluminum wire to the lamp body, and then the pretty great amount of glue should be used for fullfilling the hollow arm.

As the fourth way for repairing the damaged arm is accepted next solution: at the cavity of lamp body is remained one small pointlike pore, heavy visible. It is beleived that this pore was created during the casting process. But, the diameter of this pointlike pore, less that 0,5mm in diameter, is too small to sgueeze through a wire with diameter 3mm, and made a strong connection. In situation like this, is conlcuded that will be enough first to fasten a screw. A chosen screw is about 20mm in length, Ø3mm, and less than 0,5mm in diameter at the top. This steel screw was zinc platted (by using an ordinary galvanic process), what in this situation represents an advantage [12]. The remaining room will be fullfilled by the aluminum wire, Fig. 4b), together with a glue.



a)



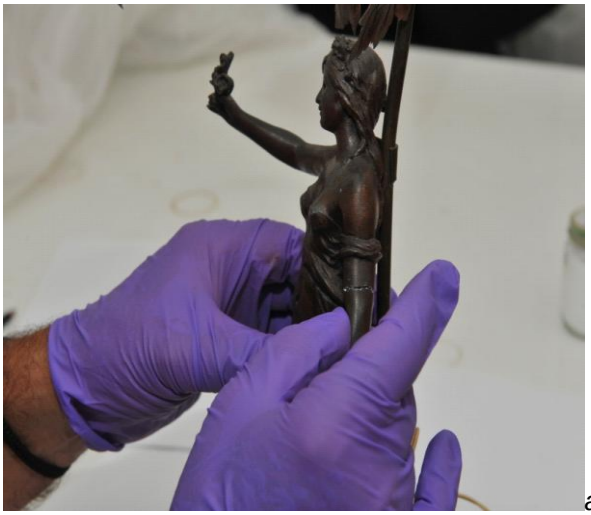
b)

Figure 4. Prepairing for reinforcing with aluminum wire

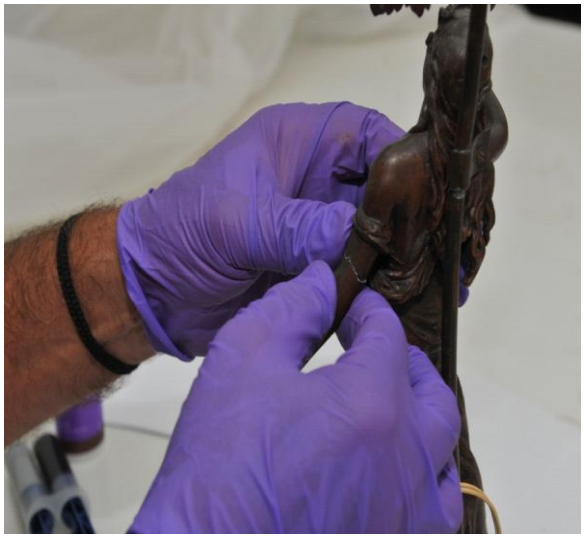
Slika 4. Priprema za ojačavanje sa aluminijumskom žicom

Repairing of damaged arm

The top of the choosen screw is twisted into the small pore, while the head of screw was in position to hang into the hollow of damaged arm. As the screw is made of steel, than the strength of such joint will be satisfied anyway, and at the same time the zinc platted surface is a properly against the parrent material, for avoiding a kind of corrosion process. Anticorrodive behavior of coating here means the avoiding so called the contact corrosion of two materials: lamp body from zinc alloy and the zinc platted screw. This way of repairing does not need an application of great amount of glue, so the risk from eventualy deformations of relatively thin walls at the arm is really decreased, even eliminated.



a)



b)

Figure 5. Keeping two components for 6 minutes after all previous works done

Slika 5. Zadržavanje dve komponente u toku 6 min. posle završenih prethodnih radnji

The bended end of the aluminum wire is hang on the screw head, and after that the cavity is half fullfilled with two component glue. Such assembly does not contains some substances even in microquantities which would change the surface appearance of the lamp [12-14]. Drying of used glue commonly is pretty short, couple minutes are enough, according to manual instructions of producer. Both parts were sticked together and hold about about 6 minutes, to be sure for obtaining the save connection. At the joined surfaces there were no registered any visible irregularities or deformations, as it was stated in [15]. Views from two side of realised joint at the damaged lamp could be seen at Fig. 5.

3. CONCLUSION

An unicate lamp accedentaly was damaged, when one arm is broken. The broken parts were not deformed, it means that the used material was a brittle, see Fig. 2, and the failure is in pretty straight line. The structure at the damaged surfaces is fully dendritic, as could be generally found in as-casted products. On the basis of material type and configuration of damaged elements are analyzed four possible ways for repairing the lamp with described kind of failure.

As the most here is chosen the galvanized steel screw. Zinc coating on screw is wellcome for the body lamp material (high percentage of zinc). Around the screw head was twisted an aluminum wire. The aluminum wire is chosen in semihard state, for achieving a good strength, and this material however will not be reactive both withparrent material or galvanized screw. Over such assembly is put on an amount of two component glue.

At the end, on joined surfaces were no registered any visible irregularities or deformations, it means that is chosen pretty secure solution for repair, as here described.

Acknowledgement

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IZVOD

IZBOR POSTUPKA REPARACIJE POLOMLJENE RUKE JEDNE UNIKATNE STOLNE LAMPE

Reparacija nekog unikatnog dela uvek predstavlja izazov i zahteva puno stručnosti i umeća konzervacije. Zahtevi se odnose na vizuelni izgled, koji što više treba da ostane neizmenjen, pa do pitanja čvrstoće kao i mogućeg odvijanja korozije nakon izvođenja svih planiranih reparaturnih radova. Ovde se analiziraju mogući postupci reparacije jedne polomljene ruke na unikatnoj stonoj lampi i detaljno je opisano izvođenje reparacije kombinovanjem armiranja aluminijumskom žicom i dvokomponentnim lepkom.

Ključne reči: *analiza oštećenja, postupcie reparacije, armiranje, lepljeje delova*

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