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HEAVY METAL CONTENTS OF NATURAL AND ARTIFICIAL UPHOLSTERY LEATHERS

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Abstract: *Textile products and natural and artificial leathers are used as flooring materials in upholstery products. Due to the expensive materials as natural leather upholstery, today. Therefore, the demand for artificial leather has increased. Because artificial products are easy to clean, light, and have good features like natural leathers, they are used as an cheap alternative to natural leather especially in furnishing industry. In this study, the amounts in natural and artificial leathers of heavy metals such as cadmium, cobalt, chrome, copper, mercury, nickel and lead, which are limited in many goods due to their harmful effects, and of aluminum and zinc, which are unlimited, were evaluated. In this research, the total heavy metal contents of the leathers were specified in ICP-OES. Then, the amount of heavy metal manifesting when the leathers were exposed to sweat and water was determined using ICP-OES. Heavy metal contents of all leathers were compared with standard limit values. Small amounts of aluminum, cobalt, copper, nickel and zinc were also found due to the chemical and physical reactions during the wet and dry finishing processes. The heavy metal detected in the greatest quantities in natural and artificial leathers was chromium. However, neither hexavalent chrome, cadmium, mercury nor lead were found in either of the leather types.*

Key words: *Genuie Leather, Faux Leather, Furniture, ICP-OES, Elements, Environment*

1. INTRODUCTION

Many different organic and inorganic materials are used during the manufacture of natural leather, and pollution is caused by the intense use and discharge these chemicals [1]. The manufacture of aproximately 90% of the natural leathers produced in the world involves the use of chrome salts [2]. However, chrome cannot give the leather all the properties and qualities desired, and so different metal salts are used in various phases of leather are not subjected to a lengthy tanning process in which heavy metals are used in large quantities.

Today, the increasing price of natural leather around the world has caused consumers to shift towards goods manufactured from artificial leathers. Since these products are easy to clean, light, and have good waterproof features, they are used as an alternative to natural leather especially in shoes and furniture.

In the manifesto of the European Union Commission dated July 12 2002, a complete ban was placed on Pb, Cd, Cr (VI), As, Hg and their compounds in textile and leather products, and concentrations of other heavy metals were limited [3]. Therefore, the aim of this research was to determine the heavy metal contents of natural and artificial leathers used in furniture. The total

heavy metal ions in leathers and the heavy metal ions that can be extracted in artificial sweat solution were determined using ICP-OES. Later, an evaluation was made of the difference between the total amounts of heavy metal in the natural and artificial leathers and their extraction levels in artificial sweat solution.

2. MATERIALS AND METHODS

Ten natural and ten artificial different finished upholstery leathers of different colors were randomly selected as research material and obtained from the Istanbul Leather Industrial Area and Menemen/Izmir Leather Free Zone, and from leather furniture manufacturers.

In order to determine the amounts of heavy metals in the leather products which could be extracted in damp conditions, extraction in water (EW) was carried out on the samples in accordance with ISO 4098:2005, and extractable heavy metal levels were determined with ICP-OES (Perkin Elmer Optima 2100 DV) [4]. In order to determine the amounts of heavy metal which can get into human sweat due to its dissolving effects when the leathers are in use, an artificial sweat solution was prepared in accordance with ISO 105-E04: 2014 [5]. After the extraction process was performed on leather samples in the artificial sweat solution (EAS) in accordance with ISO 17072-1:2011, the concentration levels of heavy metals other than hexavalent chrome were determined by ICP-OES [6]. The total amount of heavy metals (THM) other than hexavalent chrome within the samples was determined by ICP-OES in accordance with ISO 17072-1:2011 [4]. The amount of hexavalent chrome in the samples was determined in accordance with ISO 1705:2007 [4].

3. RESULTS AND DISCUSSION

It was found in this study that the values of all heavy metals in the leathers determined by wet decomposition were higher than those which could be extracted in water or sweat [7, 8]. As seen in Table 1, cadmium, mercury and lead were not found. They stated that the amounts of cadmium determined at low levels varied according to the color of leathers, and that this resulted from pigments used in the leather production process [6]. Besides, the very low levels of lead and mercury which can sometimes be determined in natural leather samples may come from the environment of the animal or the slaughterhouse.

Table 1: *Heavy metal content of leathers*

	Natural Leathers			Artificial Leather		
	EW (ppm)	EAS (ppm)	THM (ppm)	EW (ppm)	EAS (ppm)	THM (ppm)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Cd	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Pb	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Hg	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Co	0.85±0.46	2.94±2.86	31.74±29.86	0.07±0.03	0.08±0.01	0.55±0.37
Cr	72.57±31.12	168.42±38.24	16 549.00±207.25	2.09±2.01	11.48±4.69	96.90±46.48
CrVI	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Cu	4.11±3.47	6.57±11.10	53.74±40.60	0.00±0.00	0.03±0.01	0.35±0.88
Ni	0.00±0.00	0.11±0.25	0.89±2.72	0.00±0.00	0.00±0.00	0.01±0.01
Zn	0.13±0.10	1.23±0.86	11.93±10.45	0.00±0.00	0.01±0.02	0.001±0.00
Al	40.87±39.12	77.13±54.41	602.33±284.65	0.78±0.52	1.32±0.22	4.73±4.25

Table 2: *Heavy metal standards of leathers*

	Eko-Tex 100 (ppm)	SG (ppm)
Cd	0.10	
Pb	1.00	0.10
Hg	0.02	0.80
Co	4.00	0.02
Cr	2.00	4.00
Cr(VI)	0.50	-
Cu	50.00	0.30
Ni	4.00	60.00
Zn	-	1.00
Al	-	-

EW and EAS cobalt concentration values of natural leathers have been found below the standard values and THM cobalt concentration values have been found which were above the standards (Table2), [7, 8]. Cobalt may have originated from bioaccumulation while animal was alive; from the dyes and pigments, or from the machines used during the manufacturing of the leathers [6, 9, 10, 11]). Also, it has been observed that total cobalt concentration values of artificial leathers were below the limits in Eko-Text 100 and SG standard values [7, 8]. This low cobalt content of artificial leathers may be a result of metal complex pigments and contamination during processing [11, 12].

EW and EAS copper concentration values determined in natural leathers have been found to comply with limit values set by Eko-Tex 100 and SG, and the THM copper value of natural leathers has been determined to be above the 50ppm indicated by Eko Tex 100, and below the 60ppm required by SG [7, 8]. The copper detected in natural leathers may be caused by contamination during the production of leathers and metal complex based dyes used in coloring leathers [6, 11]. When Table 1 and 2 is examined, it can be seen that the entire copper concentration values of artificial leathers are much lower than the standard values [7, 8]. while the copper concentrations detected in artificial leathers, may result from contamination during production and copper based dyes.

Nickel concentration values of EW, EAS and THM present in natural and artificial leathers have been found to be below the standards [7,8]. Nickel values detected in both leather types might be caused by colorants used in leather production or stainless steel based machines and tools [6,10, 11].

Because of a lack of limit values for zinc and aluminum by both SG and Eko-Tex 100, it was not possible to evaluate conformity with standards for the Zn and Al values detected in our study (Table 2). The presence of these metals determined in both leather types may have been caused by contamination, inorganic pigments, or the water used in the production of the leathers [6,10, 11]. Besides Zn may have originated from the metabolic activities of the animal while it was alive, and aluminum is used during the tanning and retanning of the natural leathers [9].

4. CONCLUSIONS

The results for heavy metals in artificial leathers are similar to those for heavy metals in natural leathers. However, the heavy metal contents determined in artificial leathers are much lower than those in natural leathers. This is because mineral tannins are not used in the production of

artificial leathers. Although cadmium, lead, mercury and hexavalent chrome were not found in artificial leathers, and nickel element was detected at very low levels, only chrome was found in high quantities. The occurrence of these heavy metals in artificial leathers may be caused by chemical substances, dyes and pigments used in production process and by contamination from various sources. To conclude, it is expected that in the future the trend towards a demand for ecological products will have a greater effect on leather producers but that the suggested limit values may be decreased further. Therefore, the leather industry and especially natural leather processing should be prepared for these new lower limit values. Otherwise, the natural leather industry will be unable to keep up with worldwide competition, and may be affected adversely.

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