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A NEW LIFE FOR OLD FURNITURE

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Abstract:

A *solution for recycling and capitalization of the recovered melamin laminated particle boards should be found with minimum intervention by possibly refinishing them. For this study a 30 years old particle board was selected. Due to its damaged surface aspect the following objectives derived: finding opaque finishing techniques for the recovered PB and methods of finishing with special effects with minimal energy consumption.*

For the study of special effects finish on recovered PB a colouring technique of the applied paint by pigment layering was considered. The tested substrate was the unfinished PB. As a base coat KEIM Quarzil silicate based interior paint was applied, and Kremer and Sennelier mineral pigment mixed with a part KEIM Spezial-Fixativ pure liquid potassium silicate based thinner and a part water was used for obtaining the colours.

The study of the colouring method by pigment layering resulted in four deep and textured pastel colours: bluish brown, greenish sand, deep pink, greenish blue. This research shows that refinishing recovered PB with wall paint in different colours obtained by techniques adopted from interior design can be a sustainable and ecological way to recycle by reuse.

Key words: *ecodesign; recycling; recovered particleboard; colouring.*

INTRODUCTION

Although signals of environmentalism, of sustainable development and of returning to green products and service appear everywhere, today we are still in an era of consumerism. These signals are sometimes strong, sometimes weak, but always isolated in spite of national or international legislation providing sustainable development and ecology. Ecology nowadays is often seen as a fashion and some go so far as considering it "a new religion" (Olărescu 2010).

Recycling represents the process of reusing old materials and developing new products, reducing, as a result, the emission of greenhouse gases, the energy consumption required for the extraction of raw materials, or the waste disposal. Recycling is actually the basic process of eco-design strategy for extending the life of materials (Deák, Cionca and Timar 2012).

Wood recycling may take numerous forms, from using wood waste as compost, mulch, wood brick fuel, animal bedding, particle board, MDF board, furniture etc. It is important to recycle wood and wood based materials, if possible, with minimal energy consumption (Papanek 1995, Vezzoli and Manzini 2008). Reuse and recycling of wood as a material can be considered as downcycling (except reuse in a very strict way): diameters, size of wooden material pieces decrease while 'unwanted' contaminants increase with each processing step. The more often wood is reprocessed, the more limited its potential applications. Original properties can only be restored with the investment of non-renewable energy and material (Werner 2005).

Furniture has a life span of 30 to 40 years in Europe. According to environmental regulations in some European countries deploying of used furniture on the landfill are forbidden since 2005, as the interaction between organic materials and the environment is of a very complex nature. Leached binders may influence the groundwater, biological degradation leads, moreover, to the formation of methane which contributes to the „Green-House-Effect "about 80 times more than carbon dioxide (Kharazipour and Kües 2007).

Due to the above mentioned reasons, increasing attention has been given to the issue of recycling in the fibber- and particleboard industry. Many methods have been developed for the recycling of particleboards (Roffael 1997).

In wood waste management the most environmentally benign utilization - typically reuse of the material - shall be preferred. As an alternative to reuse the material, thermal utilization is to be considered (Marutzky 2006 cited by Kharazipour and Kües 2007). Combustion of discarded timber products for energy production is therefore a possibility - another is to disintegrate discarded wooden items for reuse of the wooden material for new products. Life Cycle Assessment (LCA) as defined in ISO 14 041 (ISO 1998; for special discussion of wood-based products (Jungmeier *et al*. 2002a,b 2003, Werner *et al*. 2007 cited by Kharazipour, Kües 2007) of two scenarios validates the recycling of wood waste for panel board manufacture to be more favourable under an environmental perspective than pure combustion for energy production (Rivela *et al.* 2006a,b cited by Kharazipour and Kües 2007). Most effective is probably a combination of both, material reuse and energy production from the unusable wood-based waste in a cogeneration unit that generates energy for use in disintegration of old and production of new panel boards (Kirchner & Kharazipour 2002a, Smith 2004, Marutzky 2006 cited by Kharazipour and Kües 2007), although geographical conditions of production sites have an impact on the overall energy situation (Rivela *et al.* 2007 cited by Kharazipour and Kües 2007).

For substantial recycling of wood composites such as particle boards and blockboard from discharged furniture, production remainders and rejections, the material needs to be disintegrated into small pieces. Three different principles can be applied for disintegration of panel boards: mechanical, thermo-hydrolytic and chemical, and combinations thereof. Target of any process is to harvest the highest possible mount of high quality recycling material for subsequent reuse e.g. in the panel board industry. The technical requirements for waste wood processing, for possible purification from pollutants, and for quality control of wood waste for material recycling are extra cost factors in panel board production. With rising prices and reduced supply of raw wood from forests, recycling of wood waste is nevertheless recognized an economically attractive alternative - in addition to that the material reuse brings ecological benefits (Marutzky 2006).

In this context a solution for recycling and capitalization of the recovered melamin laminated particle boards should be found with minimum intervention by possibly refinishing them.

OBJECTIVES

The objectives derived from these observations include finding opaque finishing techniques for the recovered PB and methods of finishing with special effects with minimal intervention (Deák 2012).

MATERIALS AND METHODS

For this study a 30 year old particle board was selected. The melamin laminated particleboard had numerous aesthetic defects such as scratches, peelings of the melamine foil and lastly, it was "old fashioned" (Fig. 1).

Fig. 1
Surface detail.

Before studying the special effects finish on the recovered PB, *Assessing the resistance of paint coatings to separation from substrates of finished surfaces* test had been made in accordance to ISO 2409:2007(E) *Paints and varnishes - Cross-cut test* on the paint. For this previous test a thirty year old recovered melamin laminated 18mm PB had been used as substrate, with unpickled, partially pickled, and totally pickled surfaces by sanding with medium grit (P80) and fine (P120) sandpaper. Results had shown that in case of two coatings of wall paint, only small flakes of the coating had detached at the intersections of the cuts, and the affected cross-cut hadn't been greater than 5%, Wall paint applied in two coatings on recovered PB had been classified as class 1, which means a good performance regardless of the substrate preparation method (Deák, Cionca and Timar 2012).

For the study of special effects finishing on recovered PB a colouring technique of the applied paint by pigment layering was considered. The tested substrate was an unfinished PB which resembled the totally pickled surface of the recovered PB. As a base coat *KEIM Quarzil* silicate based interior paint was applied, and *Kremer* and *Sennelier* mineral pigment mixed with a part *KEIM Spezial-Fixativ* pure liquid potassium silicate based thinner and a part water *w*ere used for obtaining the colours. The two test pieces were rectangular with the fallowing dimensions: 1000x750mm (Fig. 2).

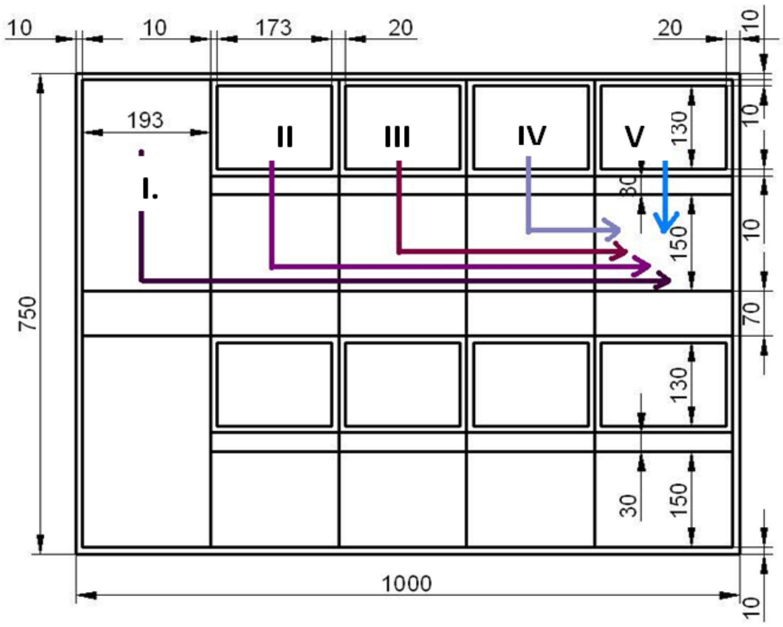

Fig. 2
Test piece: dimensions, shape and the process of applying the pigmented layers.

To prepare the substrate two coatings of paint were applied on the surface. The second coating was applied on top of the first layer after 2 hours of drying. On each test piece two layered colours were studied and as a following step each test piece was bordered on each side using a 10 mm thick ducktape, and were devised in two horizontal fields (980x340mm) with a 70mm empty space between them. The two main fields were further separated into vertically into five columns (width: 193mm). Eight cells were formed by separating the four columns, starting from the second column until the fifth, with a 30mm space between them. The top four cells (II. - V.) were encased by a 10mm thick border covered with ducktape resulting 130x173mm.

After 16 hours of drying the pigmented primer and water dispersion was applied in five different coloured layers in the following manner: the first layer for each studied layered colour was applied starting with the first cell and continuing with all the second row. For the second layer the paint was applied from the

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second cell on the first row and below, on the second cell of the second row, and all the way until the last cell of the second row. These steps were repeated for the third and fourth layer too. For the fifth and final layer the paint was applied on the remaining fifth cell of the first and second row (Fig. 2). The used pigments for each colour are shown in Table 1.

Table 1

The used pigments and their colour code

The obtained colour	1st coating	2nd coating	3rd coating	4th coating	5th coating
	44200 KROMOXIDGRÜN/ *Kremer*	206 UMBRA NATUR NATURERDE */Sennelier*	16421 ULTRAMARIN HELL/ *Kremer* +755 IVORY BLACK/ *Sennelier*	48750 CAPUT MORTUM VIOLETT */Kremer*	4081 BÖEMISCH GRÜNERDE/ *Kremer* +755 IVORY BLACK/ *Sennelier*
	40280 AMBERGER GELB/ *Kremer*	45400 ZIRKON CÖLINBLAU */Kremer*	48700 CAPUT MORTUM RÖTLICH/ *Kremer*	16421 ULTRAMARIN HELL/ *Kremer* +755 IVORY BLACK/ *Sennelier*	40545 ENGLISHROT/ *Kremer*
	40545 ENGLISHROT/ *Kremer*	45400 ZIRKON CÖLINBLAU */Kremer+* 4081 BÖEMISCH GRÜNERDE/ *Kremer+* 46900 ZINKWEβ */Kremer*	48750 CAPUT MORTUM VIOLETT/ *Kremer*	457161 KOBALTBLAU MATTBLAU/ *Kremer*	205 RAWUMBER/ *Sennelier*
	45400 ZIRKON CÖLINBLAU/ *Kremer*	44200 KROMOXIDGRÜN/ *Kremer*	40017 OCKER FRAZÖSCH/ *Kremer*	205 RAWUMBER/ *Sennelier*	45720 KOBALTBLAU HELL */Kremer* +755 IVORY BLACK/ *Sennelier* +46900 ZINKWEβ */Kremer*

RESULTS

Resulting from the study of the colouring method by pigment layering were sixteen textured pastel colours.

After applying two layers of pigmented paint resulted four light accented colours: light warm brown with green accents, sand with light blue accents, pink with blue accents and green with blue accents, as can be seen on the test pieces on the second cell from the second rows of each horizontal main field.

In every third cell of each second row, after three layers of pigmented paint, resulted also four light, accented colour, but a shade deeper than the previous ones: cold brown with blue accents, light orange, warm pink with brown accents and warm green with blue accents.

In each fourth cell in every second row the colours get more saturated: warm brown with blue accents, light warm brown with blue accents, cold pink with blue accents and a deeper green than the previous one with blue accents.

The last cells of each second row show four deep and textured pastel colours bluish brown, greenish sand, deep pink, greenish blue (Fig. 4). The evolution of the colours after applying each layer of pigment can also be seen on the test pieces (Fig.3).

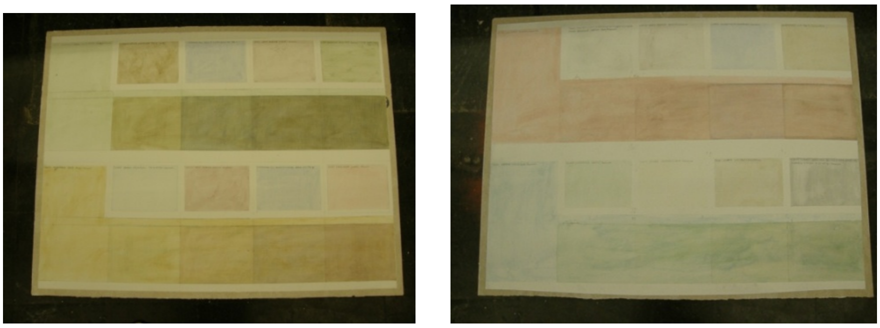

Fig. 3
Test pieces: original colours in the first rows of each horizontal field and the evolution of the layered colours in the second rows.

Colours get deeper and richer if two apparently unmatching shades are combined, as seen in the case of bluish brown, the last two layers were light blue and violet (Table 1).

The applied shades have to be light enough to allow the other layers to be seen. In the case of deep pink, the first layer of red was too strong and blocked the other layers (Fig. 3).

Applying any type of blue tends to influence very much the previous layers. Blue changes the colours to colder shades and the blue is the dominating accent.

a **b** **c** **d**

Fig. 4
The resulted colours
a - bluish brown; b - greenish sand; c - deep pink; d - greenish blue.

Although the surface of the coloured recovered PB has to be protected with transparent lacquer which is compatible with the used paint, this study show that refinishing recovered PB with wall paint in different colours obtained by techniques borrowed from interior design can be a sustainable and ecological way to recycle by reuse with minimum material and energy consumption.

CONCLUSIONS

This research shows that refinishing recovered PB with wall paint in different colours obtained by techniques adopted from interior design can be a sustainable and ecological way to recycle by reuse.

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