Colour in Recycled Crystal

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ABSTRACT

Colour is what allows us to distinguish the world around us, through vision and light our eyes capture the colour of the objects. According to Daniel Beresniak, "colour is the effect produced by a reaction of these three variable elements: the object, the lighting and the eyes. Colour is the light reflected by a body. It depends on the incoming light (intensity and colour of the light) and the body own characteristics" (2000, p.15). The colour only exists if there is light. This paper aims to show the colour in crystal. Crystal is glass with the presence of lead that makes this glass the purest one produced by the technosphere. The common glass denominated by Sodic -lime glasses are glasses used in plan glass manufacture, container glass (bottles and jars), articles for civil construction (bricks, blocks, tiles and shingles), articles for housing and public lighting (globes , lamps, etc. .). These don't contain lead oxide or other more expensive materials: they are glasses that typically have green coloration (transversely more visible) due to the presence of iron oxide. Glass is by definition every mineral substance that at ordinary temperature is a nonsolid and a nonliquid. According to Navarro " even at room temperature they have the appearance of a solid body that provides mechanical rigidity , however it cannot be considered as such since it lacks of a crystal structure that characterizes it and defines the solid state . If by its stability the glass could be compared to solid, from the point of view of its structural disorder, its similarities are much more evident with liquids". Glass is more or less transparent and sometimes translucent, it has a special brightness , insoluble in almost all known substances at a normal temperature; it is amorphous (as opposed to crystalline), it is solid-coloured or colourless, odourless; it can be smooth or it can have a texture and become one of the brightest surfaces obtained by technosphere processes. It results from the mixture of different silicates obtained by fusion in which alkali metal silicate and calcium are predominant. Crystal by its commercial demands is a glass that has a large volume of waste during its production: about 30% to 40 % of its daily production is transformed in cullet and at least 50% of this is wasteful. On average, in the only Portuguese factory that produces crystal there is a daily production of 700Kg of crystal cullet waste. As this waste contains lead, they can't be recycled along with the ordinary glass. This is the starting point of this research project: the reuse of the crystal cullet waste, analyzing its behaviour accordingly to the colour.

Keywords: Crystal, recycling, colour.

INTRODUCTION

Crystal is collected in the form of broken glass (cullet). Then, is subjected to a separation process , by particle size of broken glass in order to get different results depending on the size of the pieces of glass; later these are merged into moulds. We can obtain different type of results according to the combination of the particle size of the cullet with temperature.

Colour may be added to the crystal by different processes: one can add pigment to colour the glass; or making it opaque; to introduce coloured glass or to work the transparent glass with colour light.
Crystal can be one of the most sparkling materials ever produced by Men, as already been told, without a texture, smooth and a light reflector, but it can also have a texture without any prejudice for the light refraction.

Texture

As Giulio Bertagna (2013) says, the texture that exists in any object has to do with the distance to which the observer is, to have the real perception of its texture, we can have a proximity relation with the object and still distinguish all its texture's details, or a distance relation and then we can have the perception of an intrinsic texture given by its engaging whole. In a crystal object the texture can be given by the module or by the set of modules. A highly textured object will influenced the perception that the observer has according to the object's colour, for it can generate shadows and present a more saturated colour than it really is, so the texture communicates with the observer.

Also Pernão and Durão (2006, p159) reinforce this idea when they affirm that "the texture can be understood as an appearance variation of the colour of the surfaces, always depending on the distance of the observation. If any surface is, for example, more wrinkled, it is so, because to a micro scale, there will exist parts of that same surface that will acquire several positions relating to the main source of light, and that will provoke a changing of the colour perception of that surface."

Photo 1 - Crystal piece with a partial melting which gives it the texture according to the dimension of the particle size of the broken glass. Source: Author

The texture in recycled crystal can be assigned to the final aspect of the material by two types of intervention, united, the melting temperature and the melting particle size of the material.

By this we can obtain a smooth and shinny surface when the temperature becomes equal or higher than 850º degrees, or a much more textured and equal shinning surface, if the temperature becomes lower 700º degrees, from this temperature until the minimal bonding temperature, about 650º degrees, there only exists a superficial melting of the glass, and the texture is much more revealing of the particle size of the crystal, this melting is by itself sufficient for a slight melting of the several pieces of the glass putted inside the mould, shouldn't this be used for bigger pieces and neither with particle sizes in which the crystal is broken into pieces of bigger dimensions. The

larger the particle size of the crystal pieces, the higher should be the melting temperature, so that the connections of the parts be more effective. The texture can still be instilled in a crystal piece by posterior actions to a first melting of the piece.

Texture applied by gluing of other pieces – after the producing of the pieces through a melting process in which the surface is smooth and shinny, it is possible for them to return to the oven so that in a specific place another part of the glass be glued in order to grant it a localized wrinkled texture. The glass, through the thermal action, stops being cutting because the edges become rounded, allowing the use of these textures in places where the physical contact is possible.

Texture applied by thermoforming – the piece, after being melting, can be putted on a textured mould which, by temperature's action, will acquire the texture of the mould.
After this, the texture can exist in the entire object surface or only be localized, and this allows to play with a whole set of pieces or just with one single piece.

The Colour in the Crystal

The colour in the crystal may be applied by two processes, the physical colour into the material through the pigment and the ephemeral colour applied by the light in the crystal.

The Colour Through Pigment

Photos 2 and 3 – Manufacturing process: Crystal powder mixed with pigment before the melting process. Author's Images.

When we think about applying colour into the crystal through the pigment, the result is a not homogeneous material, without transparency, an opaque material with a low shinning aspect but with a saturated colour. If we wish to obtain a shinning aspect, the colour won't be homogeneous and it will have a dissipated aspect in the translucency of the recycled crystal.

In order that the saturation of the colour is more effective in the recycled crystal, this should be milled into a fine grain and to be mixed with the powder pigment, the result should be a material with a stony appearance of little shinny. The most effective option so that the crystal can keep their characteristics and shinning, will be the placing of the pigment among layers of colourless crystal.

This way we can obtain a mote textured aspect in the surface of the object, which allows multiple readings of the colour according to the angle and distance point of observation.

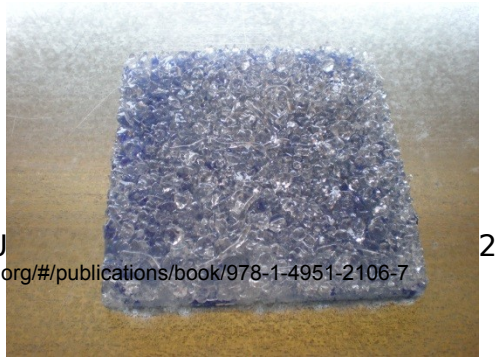

Photo 3 – Crystal piece with inserted pigment between layers of transparent crystal, melting with a low temperature to allow the texture in the piece. Author´s Image.

The Light and the Crystal

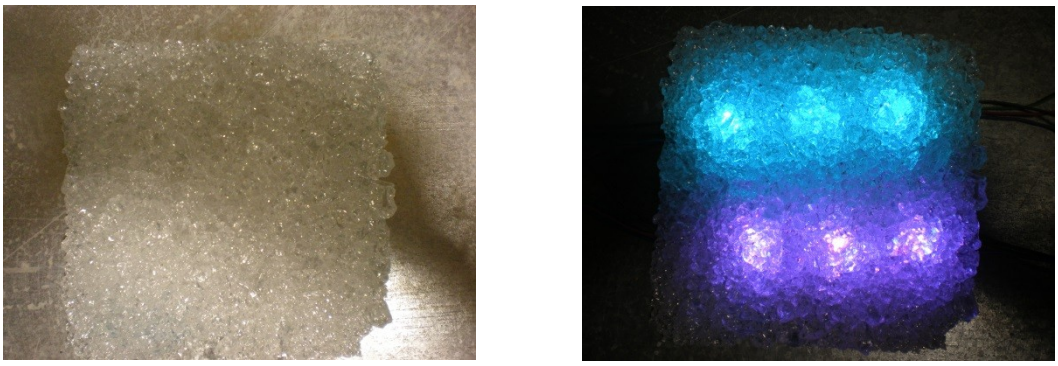

Photo 4 – Crystal piece with and without backlight. Here the crystal acts as an issued light diffuser. Author's Image

Because of its purity, even after recycled, the colourless crystal does not change the colour of the light that goes through it, enabling a reading of the issued colour without any interference. This way, the issued colour by a light source is filtered only by the texture that the material might have, the more textured is the crystal piece, the more dissipated will be the issued light, originating small shadows, causing the light to be more saturated.

CONCLUSIONS

In ergonomics, to create environments, it can be fundamental to have a material that allows an easy cleaning, it should be appellative, and it should also allows the chromatics variation without having a domineering presence of the space.

The recycled crystal allows that. It has an easy cleaning surface, even when it has a textured surface, the dust and dirty accumulation is really minimum and its cleaning is easy, either with water or with a damp cloth. Grease is one of the most difficult dirtiness to eliminate from any surface, in recycled crystal it is not necessary to use chemical products, for it is not a transparent material, and so, the cleaning of any surface of a recycled crystal becomes more economics as well as more ecological. If we want to eliminate the whole grease from the surface of a recycled crystal, we just need to add a little of alcohol to the damp cloth.

As it has already been told, the recycled crystal enables the colour, and the colour can have quite a lot of readings in indoor spaces, according to Joan Costa[1] (2011, p 59) "The Colour Semiotics, that is, the meaningfull part that the colour confer to an image or draw, it is the function of the two components: the chromatic degree of iconicity (relative correspondence between the colour, the shape and the represented reality) and the psychology of colours, that is, what the image in its whole evoke beyond what it represents – the inner intimacy or the golden lightness of a vesper, for example, - where each represented element has the colour that identifies it (the sky, the leaves, etc.), but the whole set has got an atmosphere, a shade or even an expressivity that is beyond the particular colours of things and links the image to feelings and emotions."

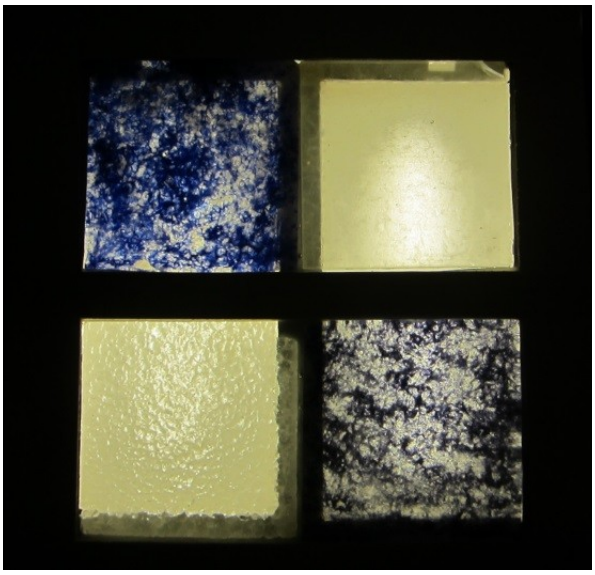

Photo 5 Crystal pieces with backlight, with and without pigment, the colour of the light into the colourless crystal piece more textured, looks more saturated.

The chromatic variation of the recycled crystal can be reached by placing pigments into the mixture, before the melting of the materials to recycle. If we want to achieve a more saturated colour, the pigment should be mixed with all the matter to be melted, achieving a material of a more saturated colour and without any transparency or translucence. We could, however, choose a less saturated colour, if the pigment is placed between colourless crystal layers, allowing us to have a surface with some translucence that enables the passage of light.

Another hypothesis of chromatic variation applied into this study goes not from a permanent physical modification of the material, material, such as the one produced by the pigment when mixed into the crystal before the melting, but rather searching for relief into a light source later applied to the crystal, where this one will serve the purpose of a filter, enabling a bigger or a minor effect of diffusion of the light whether the crystal piece is more or less textured. This process is a totally reversible process, as we can eventually recycle again the crystal piece.

REFERENCES

Bertagna, G. (2013). Tessiture - Textures - Il fascino delle tessiture apparenti [Electronic Version]. Retrieved 15-12-2013 from http://giuliobertagna.webnode.it/texture/.

[1] Costa, J. (2011). *Design para os olhos - Marca, Cor, Identidade, Sinalética*. Lisboa: Dinalivro.

Costa, J. (2011). Design para os olhos - Marca, Cor, Identidade, Sinalética. Lisboa: Dinalivro.
Navarro, J. M. F. (1991). El Vidrio (2ª ed. Vol. 6). Madrid: Consejo Superior de Investigaciones Cientificas.
Pernão, J. N., & Durão, M. J. (2006). Elementos para um novo entendimento da cor como geradora do espaço e do tempo. Artitextos(03), 149-178.
Marques, F. M. (2012). Cristal valências do desperdício para o design: Abordagem à reciclagem de pré-consumo de cristal. Unpublished PhD, Universidade Técnica, Lisboa.
Norman, D. A. (2004). Emotional design: Why we love (or hate) everyday things. New York: Basic books.
Pascual, E., Philippa, B., & Doménech, I. (2004). O vidro. Técnicas de trabalho de forno (M. Costa, Trans. 1ª edição ed.). Lisboa: Editorial Estampa.
Vezzoli, C., & Manzini, E. (2007). Design per la sostenibilità. Bologna: Zanichelli.
William, M., & Braungart, M. (2002). Cradle to Cradle. New York: North Point Press.