

# PROPOSAL OF LCA AND CIRCULAR ECONOMY CONCEPTS IN THE APPLICATION, PROPERTIES DEVELOPMENT AND IMPROVEMENT FROM A PREMIUM ACRYLIC EMULSION ADDED WITH AQUEOUS DISPERSIONS OF CELLULOSIC RESIDUES TREATED BY ELECTRON BEAM

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## 1. Objective

The aim of this project was to propose the application of the concepts of Life Cycle Assessment (LCA) and Circular Economy in a premium acrylic emulsion paint and to improve the properties of this paint by means of the addition of aqueous dispersions of cellulosic waste processed by an electron beam accelerator.

## 3. Results and Discussion

The results were determined according to Abrafati's QSP methodology. An interesting result obtained was the wet hiding power of the paint, according to Table 1.

**Table 1 - Wet hiding power of the paint.**

Name	Wet hiding power (%)				
	CP01	CP02	CP03	Results	Specifications
Control sample	95.69	95.43	96.24	95.79	≥ 90%
FCN 5%RC 5kGy	94.20	94.41	88.93	92.51	≥ 90%
FCN 5%RC 50kGy	95.65	94.04	90.76	93.48	≥ 90%
FCN 10%RC 5kGy	93.88	91.23	94.79	93.30	≥ 90%
FCN 10%RC 50kGy	93.25	96.06	95.35	94.55	≥ 90%

It should be noted that all samples had an excellent behavior when exceeding the minimum required standard that is to have a degree of coverage higher than 90%. On average, the samples had a coverage power of 93.46%, which is excellent. Another test was the determination of the specific mass, which is shown in Table 2.

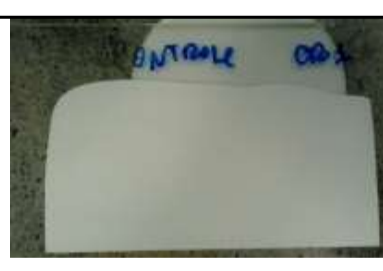



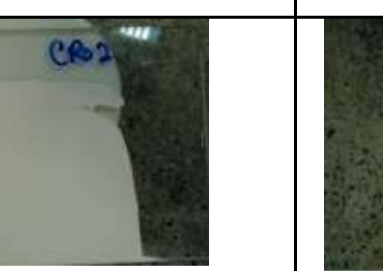
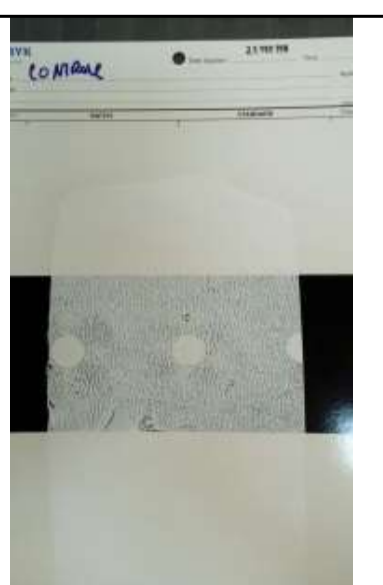
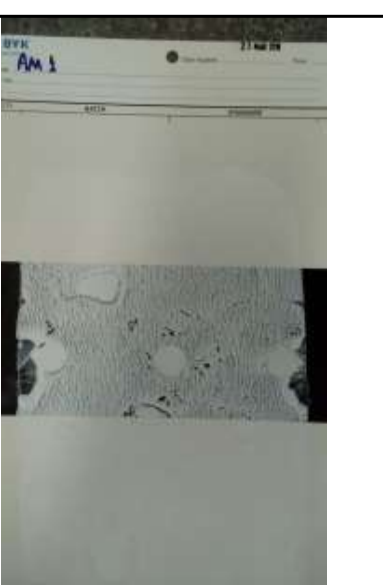
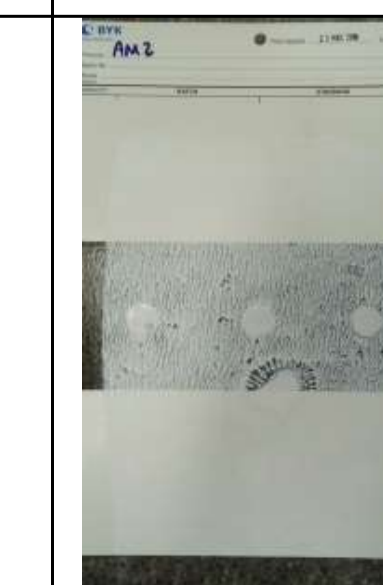
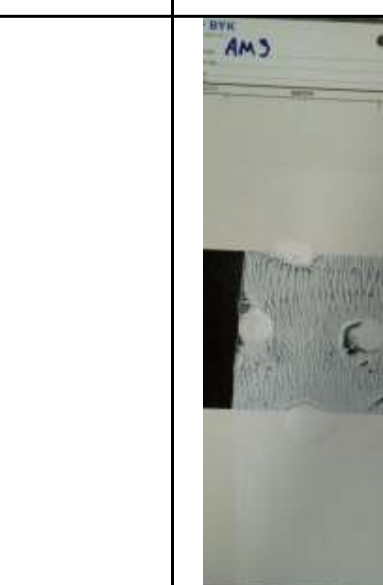
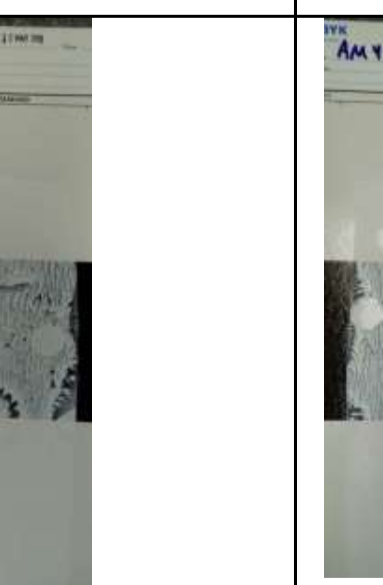
**Table 2 - Specific mass.**

Name	Specific mass (g/cm <sup>3</sup> )	
	Results	Average specification
Control sample	1.39	1.20 - 1.50
FCN 5%RC 5kGy	1.36	1.20 - 1.50
FCN 5%RC 50kGy	1.35	1.20 - 1.50
FCN 10%RC 5kGy	1.34	1.20 - 1.50
FCN 10%RC 50kGy	1.36	1.20 - 1.50

It is also worth noting that, in relation to this control parameter, the results obtained were within the specified mean, which determines a range between 1.20 and 1.50 g/cm<sup>3</sup>.

In Figure 1 presented in the sequence it is possible to observe the results of appearance and the wet coating power tests. In these, it is observed that there is practically no difference between the standard presented by the control samples and the project samples.

**Figure 1 - Wet hiding power tests.**

Paint aspect				
Sample control	FC5%RC 5kGy Am1	FC5%RC 50kGy Am2	FC10%RC 5kGy Am3	FC10%RC50kGy Am4
				
Wet coating power [4]				
Sample control	FC5%RC 5kGy Am1	FC5%RC 50kGy Am2	FC10%RC 5kGy Am3	FC10%RC50kGy Am4
				

## 5. Acknowledgments

Our recognition to the Nuclear and Energy Research Institute (IPEN-CNEN/SP), Mario Amato SENAI School, for the research support kindly granted

## 2. Introduction

The present study had as object a real situation of paint formed by acrylic emulsion. The research is relevant since the segment accounted for 83.3% of the volume of all paints produced in Brazil in 2017 and, in 2016, had a net revenue of US\$ 2,352 millions. In addition, the Brazilian market [of such paints] is one of the five largest in the world.

The objective of the research was to improve the properties of the premium acrylic emulsion by means of the addition of an aqueous dispersion of cellulosic residues treated in the electron beam sequence. Among the main reasons that contributed to this work are: the survey of environmental impacts through the use of LCA (Life Cycle Assessment), and the support of scientific work applied to paints, which was to demonstrate the possible environmental impacts of building materials formulations; the application of the concept of technical cycle advocated by the circular economy philosophy as a way of sustainable contribution; use of cellulosic paper waste in a recycling process, as a raw material in the paint industry, avoiding the extraction of extra natural resources (cellulose, minerals, among others); treatability of cellulosic aqueous dispersions with electron beam for lignin breaking and process hygiene; the possibility of developing a new paint with recycled materials, within the quality standards of QSP (Sectorial Quality Program) of the paint segment and finally the improvement of the biodegradability and cost reduction of the final product, and making the paint more sustainable.

The applied methodology was a case study. As research instruments, technical papers, theses, dissertation, technical standards, research in specialized sites and the use of results developed by the researcher through laboratory tests in SENAI and IPEN-CNEN/SP.

Cellulosic residues obtained from the wet wipe manufacturing process were used in the study. The material comes from an industrial process, whose generation of waste by the organization that is contributing to the study is around 35 tons/month on average, which has generated an average cost of R\$ 3,000 (three thousand Reais) or the equivalent of US\$ 825 (eight hundred and twenty five dollars).

## 2. Methodology

The experimental part consisted of the preparation of aqueous dispersions of cellulosic residues, made with 5% and 10% of residue by mass. These dispersions were then treated with electron beam (ionizing radiation) at levels of 5 kGy and 50 kGy and used as an additive in a decorative paint (premium type). In this first study we choose to prepare five samples types : a) control, b) addition of 5% by volume of cellulose dispersion treated with 5 kGy; c) addition of 5% by volume cellulose dispersion treated with 50 kGy; d) addition of 10% by volume of treated cellulose dispersion with 5 kGy and finally the sample with addition of 10% by volume of cellulose dispersion treated with 50 kGy;

These samples were submitted to the paint quality tests according to the QSP (Sectorial Quality Program) of the paint segment, developed and coordinated by Abrafati (Brazilian Association of Paint Manufacturers), of which one of the paint that are part of this program is the premium latex paint (acrylic emulsion) object of this study. The following tests were chosen: performance, wet hiding power, dry hiding power, specific mass and visual appearance on a glass plate.

## 4. Conclusions

Based on the obtained results it is concluded that, despite the studies being in the beginning, the objective was reached, and that it is certainly possible to use aqueous dispersions of cellulosic residues treated with electron beam (ionizing radiation) as a architectural premium paint additive. The data presented in this study confirm this hypothesis. Remembering that the study serves to carry out an environmental inventory of the paints area by means of the LCA and made possible the application of the Circular Economy philosophy concepts, within the technical cycle, by giving a more noble destination to the cellulosic residues. From the paint perspective, it should be emphasized that it can be an opportunity to develop a new raw material, which contributes to social, economic and environmental sustainability by preserving natural resources as well as utilizing and increasing the lifetime resources in industry processes.