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SUBSTRATS USED AS OUTDOOR ADVERTISING MEDIA

Fernanda Viana and Jorge Neves
Department of Textile Engineering
E-mail:fviana.fv@gmail.com / fviana@ufp.edu.pt; jgneves@det.uminho.pt

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ABSTRACT

Currently, outdoor advertising is particularly present in urban space. Hundreds and hundreds of square meters of polyester coated by polyvinyl chloride (PVC) dress ours cities. Facades, walls and gables earn a new expression, sustaining huge canvases printed with advertising and propaganda messages. Although the regulations which expressly forbid the use of non-biodegradable materials for display advertising messages, the reality is quite different. The use of media and ink disrespecting the regulation, along with design and construction of the creative message without take into account the environmental concerns will be focused in this study. Contribute to a responsible consideration and find solutions that can reverse or minimize the problems currently caused by the use of advertising media which harmful the environment and human health will be subject of analysis in this article.

1. INTRODUCTION

Just a closer look around us and we realize the blend of advertising elements that interact with us in the urban space. A part in the cultural field, outdoor advertising appears as a native species in the"(…) ambiente artificial que o homem cria para si próprio." (Moles, 1969, p.14) *(our translation: artificial environment that man creates for himself*). When we walk on the streets of the urban space, several advertising messages appear before our eyes. With intent to capture our attention, during the daily trips, outdoor advertising takes control of public spaces, as a main channel in establishing and maintaining relationships with the observer. The special need to reach audiences, finding new ways and instruments able to get to the expectations and objectives of the advertisers, it's able to promote a communicational relationship with their environment.

Architectural elements, infrastructure, gardens, vehicles, furniture, people and, *naturally*, outdoor advertising have contribute to new visual configuration of the urban landscape (Pires, 2004). The presence of advertising, among with other elements related to the city environment, promoted a *dialogue* able of catching the attention and at the same time reaching the communication predefined objectives (Moles, 1969). The city sees its strategic places of exposure filled by huge canvases posted on facades, gables and walls (binding or fence). Attending to the concept of urban space of Arnheim (1983) based on the visual perception as a resulting of the relationship between objects, or the object and the individual, reflects the study of Pires (2007) about the relationship between billboard and city landscape. Also Youyeon (2006, p.5) shares this view of the urban structure elements as part of the individual "(...) When walking through the streets, people are affected in one way or another by look of buildings and their arrangement in space." We became aware of the importance of structural elements in the configuration of urban space. Youyeon (*ibidem*, p. 1) reinforces this idea, saying the streets emerge as cultural exchange spaces, where individuals move, intersect and interact with each other. The outdoor advertising, necessarily place in the public sphere, has certain responsibilities in the construction of the individual. In fact, we are impressed and seduced by images and texts, strategically selected and placed on the platform that presents itself before our eyes. In this trade environment, outdoor advertising "(...) emerges as a particular character sometimes forming visual nodes (...) the factor of the whole experience is the urban space "(*idem, ibidem*). To Youyeon (ibidem) billboard advertising presents as a *native* urban element, provoking and promoting experiences during our daily routes. It is based in this perspective that Espinosa (2002, p. 1) considers the urban environment as form of communication, supported by "(...) billboards, promotional facades, panels, lights, graffiti, finally, all the graphic manifestations of covering spaces city (...).". The contemporary society presents itself supported by the image, the representation of things, ideas and concepts. Considering this analysis, the intervention of outdoor advertising seems limited to the visual content and privileged location.

Frequently viewed as a contributing to visual pollution in cities, the outdoor advertising carries the responsibility to fit between the "(...) elementos esteticamente agradáveis no ambiente urbano." (Minami, et al., 2001). The authors emphasize, "(…) a fim de criar uma sensação visualmente agradável às pessoas. (…) Os elementos que compõem o cenário urbano devem estar ordenados de forma harmônica, que possa ser apreciada." (*idem, ibidem*) (*our translation: to create a visually pleasing sensation for people. (…) The elements of the urban landscape should be arranged in a harmonic way, which can be enjoyed*) Vargas *et al*.

(2002) go much further, believing the advertising has guilty by the illegibility of urban spaces. In fact, the boundaries between outdoor advertising and visual pollution are reduced, however, as the authors, we too share this view based on the concentration of advertising in a certain space leads to saturation and difficulty in understanding the contents. If we establish a relation between the creation of an advertisement, in any outdoor advertising, it is imperative to promote communication as well as it is important to know how to use (and abuse) of visual communication techniques as a powerful message instrument. In continuously evolution, the city, a privileged space for the insertion of large format outdoor advertising, acquired in recent decades, a contemporary architectural expression and road infrastructure which achieve more speed. Specifically, the advertising has adapted to the city, taking advantage of the space opportunities and the maximization of the message. The location becomes as a major factor in selecting the spaces to put advertising, taking advantage of high road traffic and pedestrian areas. According to a study that sought to understand the spatial behaviour of large format outdoor advertising in the city, Viana (2009) concludes the higher adaptability degree of this advertising medium to the support structures, plus the power of creativity are indicative of the high attractiveness of visual and emotional impact related to the large format. Taking into consideration the built structures, the selection of strategic spots in the space, become interesting places to put advertising messages.

2. OUTDOOR ADVERTISING

Advertising enhancer, considering the dimension, legibility, versatility and adaptability to the support structures, the large format shares with us the urban public space, as we saw before. As part in the develop of individual identity, the large format tries to establish a closer relationship with the city space, this connection is reflected in finding the best advertising solution, considering the configuration of the city, the architectural and landscape elements and the concentration of road and pedestrian traffic. This large advertising medium stimulates the establishment of a closer relationship with the support structure and surrounding elements, audience and location. We present some examples of the *dialogue* between the outdoor advertising media and the urban space:

Nespresso	UZO	Ramos Pinto

Figure 1: Examples of outdoor advertising in Porto

2.1. Environmental Impact Considerations

World production of polyvinyl chloride (PVC) amounts to 20 million tonnes per year, a significant part is used as coating for the manufacture of advertising media. The products of PVC can be rigid or flexible structures, depending on the use of additives (plasticizers and thermal stabilizers). Attending to its features, including low flammability, no odour, colourless, high heat and UV light resistance, valuable processing characteristics and low cost, the polyester coated by PVC has become one of most used materials for printing advertising and propaganda messages.

In the last years, PVC has been a target of contentious discussion, several contradictory opinions in technical, scientific and economical fields, were issued about its effects on human health and environment. In one hand, it's presented the physical and economical features which promote its massive utilization, in the other hand, it's mentioned the high environmental impact resulting to its production and end of life. Indeed, PVC is a valuable product for the industrial manufacturing and for the world economy, according to information from the European Plastics Converters (EuPC) industrial production and processing of this polymer in Western Europe comprises more than 21 000 companies about 530 000 jobs, with a turnover exceeding 72 billion euros. However, the European Commission, taking into account all the ecological problems generated during the lifetime of PVC, decided to assess the environmental impact of this product, developing a directive proposal focus to regulate and observe high principles of production and waste management of the polymer. There are four main options for waste management of PVC:

- Mechanical recycling, a process where the PVC waste is treated by shredding, crushing and screening, in particular rigid PVC, window frames or pipes.

- Chemical recycling, it's the decomposition of the polymer molecules in the original ones, such as hydrocarbons in order to be used in the reconstruction of the polymer. This process is

expensive and is for plastic waste blended with other materials such as textiles or metals.

- Incineration and co-incineration treatment by municipal waste incinerators and in blast furnaces and cement kilns. This process is used for energy recovery, however, it is necessary to neutralize the hydrochloric acid (HCl) avoiding its release into the atmosphere, except in cases where is used a technology which recovers HCl. Waste from the cleaning of flue gases, is classified as hazardous waste under Council Decision 94/904/EEC, its destination is the landfill - the only option for Member States (there is some exceptions).

- And landfill, this is the common solution used for the end of life of polyester coated by PVC, attending to the economical reasons mentioned before.

Every year, millions of square meters of polyester coated by PVC are produced and printed with advertising and propaganda messages, then strategically placed in the urban space. The waste management of PVC has been, particularly in the last years, the target of review attending to its constraints, particularly economical ones related to the chemical and incineration recycling, options less used.

All the creative and print process of a large format outdoor advertising have some parameters in order to provide an effective response to the communication strategy. After receiving the briefing, the first step is to have information about the market of the advertiser and its audience as stand to define the communication strategy. In this strategy is defined the creative concept, in other words, the basic idea that will sustain all the advertising campaign, as an example, in the perfume campaign for AXE, the creative concept is "to be irresistible" and "get all the women" . If notice over time AXE's ad campaigns are supported by this key idea: or a girl wakes late in the morning and puts the boyfriend scent of AXE, then all women are interested in her, or another example, a man who turns to chocolate when puts the AXE, well is creativity! Next stage is the creative field. Visual and linguistic messages will be designed. To do that, several studies of forms (organic or geometric), colours, lettering, images (photographic or vector) take place. After selected the advertisement that best fits the communicational objectives, it's time to prepare the file. Assuming only printed elements, without the application of graphic elements cut in adhesive plastic (vinyl), the polyester coated by PVC is covered with ink by a large format digital printer, using the technology drop-on-demand (DOD). Specifically, the ink is dropped only where needed to create the advertisement on the media by electrical discharges. In most cases, after printing, is necessary to join the several pieces to finish the billboard, commonly named "tiles". Using equipment which temperature can reach 600 ºC, "vulcanize device", the tiles are joined, overlapping about an inch of both tiles. This process is called "vulcanization". Only when is justified, is placed around the perimeter a strengthening (strap), once more applied by "vulcanization". To finish the advertising media it's necessary to consider its application on the support, because it can be fixed by eyelets or using steel cable which is inserted into the holder through a sheath. Then is taken to where will be posted, on a gable, a wall or a facade. After accomplish its communication goals, the billboard, more precisely, the media enters in the waste management process.

Unfortunately, we can not have certainty of the amount of polyester coated by PVC used as an advertising medium that annually reach its end of life, because part goes to private bonfire after re-used as coverage or other temporary situation, only a leftover is sent to solid waste management. Intentional or accidental fires in landfills contribute to dioxins and furans generation, causing serious damages to society. Today we see, with the purpose to minimize the environmental impact of advertising media, a growing of recycling waste of these materials. As an example we call attention to a company, financially supported by the Portuguese Government, dedicated to the creation, production and marketing models for fashion accessories, the best known are ladies' wallets made from printed media, after done its work in an advertising campaign.

2.2. Visual Content Considerations

One study, based on the visual elements of sixteen printed media outdoor advertising, posted on facades and gables, located in Porto, was undertaken in order to verify whether a reduction in print area could change the visual perception of advertisement. The procedure to prepare the visual content was based on colour change. In other words, we reduced the printed area and thus the amount of used ink, by changing the original colour of the background to white, keeping the communication purposes. Forward are presented some of the billboards taking in the study, in order to illustrate the chromatic variation. The left column corresponds to the original billboard and the right to the proposed.

Original	Proposed
	

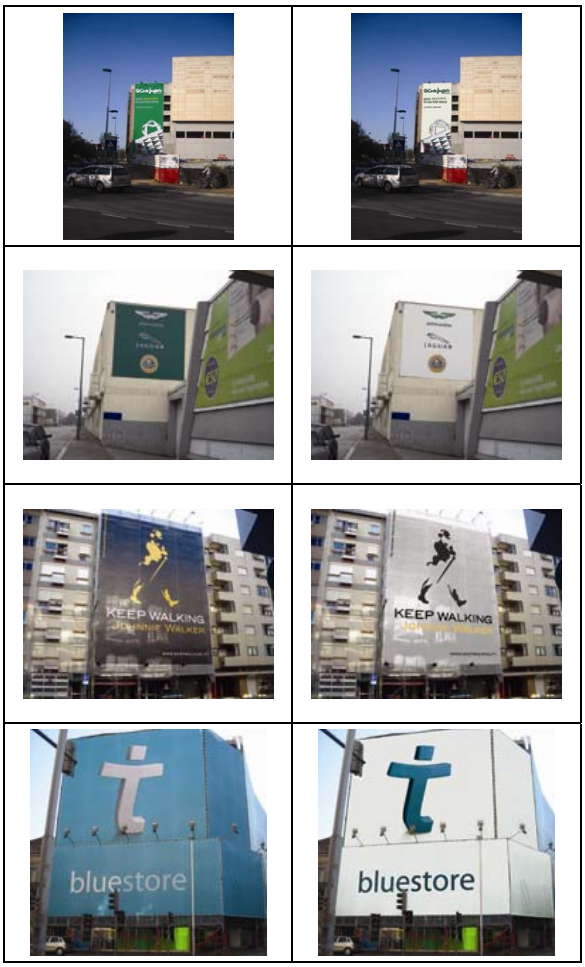
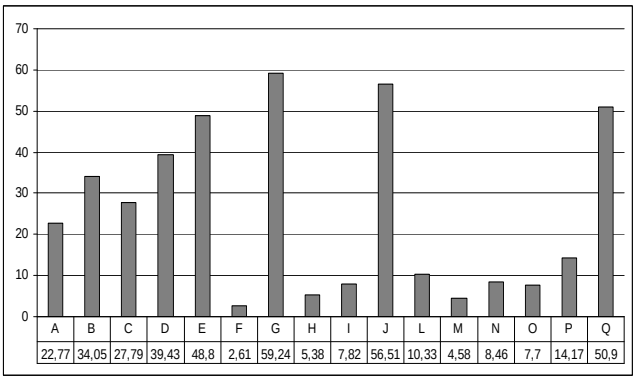


Figure 2: Chromatic Variations of the billboards

In the first case ("Dolce Vita" billboard), the printed area of the proposed billboard is only 34% of the original. In the second, "El Corte Inglés" the printing surface proposed is only 39% of the original. For "Jaguar" billboard, the print area proposal is about 5% of the original. The printed area of the "Johnnie Walker" billboard in the right column is about 8% of the area of the original. And the "TMN" proposed billboard corresponds to 5% of the original one. In general, for the sixteen billboards in the study, the printed area proposal reaches an average of 25% of the original, which means a reduction of 75% of the printed area. For detailed analysis is presented a graph, where is mentioned only the percentage of the printed area of the proposed billboard regarding the original one.



Graph 1: Proposed Billboard percentages

In general, we notice a decrease of 75% of the print area. In eight of the sixteen billboards the reduction was more than 85% and three exceeded 95%.

In order to verify whether the changes made in the graphic elements could result in a visual perception change of the content of billboards in the study, we carry out a questionnaire involving 1232 finalists of Communication Sciences fields to examine carefully each versions, original and proposal. Following a quantitative methodology and subsequent preparation of data analysis through a scientific program, Statistical Package for Social Sciences (SPSS), we conclude, in general the visual perception of proposed billboard is better than the original. Therefore, the changes contributed to a decrease in the amount of ink and consequent lower environmental impact, allowing a better visual perception of the content of the advertisement.

3. A BIODEGRADABLE SOLUTION FOR OUTDOOR ADVERTISING

Every effort to minimize the environmental impact caused either by the advertising medium itself, either by inks used in printing advertising and propaganda campaigns should be considered priority. Today, companies are focused on developing and using environmentally friendly technologies, looking for viable solutions to attempt climate change. Moreover, legal restrictions imposed by the Portuguese Government regarding the display of media advertising and propaganda messages are also revealing the urgency to reduce the ecological impacts caused by the high number of harmful materials used as advertising media. Paragraph 2 of Article 4 of Law No. 97/88 of August 17 with the new given by Law No. 23/2000 of August 23:

> *É proibida a utilização, em qualquer caso, de materiais não biodegradáveis na afixação e inscrição de mensagens de publicidade e propaganda.*

(our translation: is forbidden, in any case, the use of non-biodegradable materials in the display of advertising and propaganda messages)

However, just we just need to take a few minutes to see the high use of polyester fabric coated by PVC (in smooth or perforated) for outdoor advertising on a gable, wall or facade. In general, a smooth texture support has 76% PVC and 24% polyester and the perforated 67% PVC and 33% polyester, according to information provided by a national producer of textile coatings.

Currently, some municipalities are more receptive and interested in approval and licensing of media installation, thus providing more advertising large format. This would not be serious, if there was compliance with statutory requirements in relation to chemical composition of materials used for displaying advertising and propaganda messages.

First, the concept of biodegradability should be understood as organically recoverable. The proportion of total organic constituents without degradation determined should not exceed 5%, according to the European Standard EN 13432: 2000 concerning the requirements for packaging recoverable through composting and biodegradation. This is the standard applied for the certification of materials to be authorized as "OK Compost", "OK Biodegradable" and more recently for materials produced from renewable sources "OK Biobased" by Vinçotte, one of the European entities that certify, inspect and control a variety of applications in different industrial fields.

3.1. Study Samples

Attending to all the problems generated by the impact on society by media advertising, we proposed to search and develop a solution that would minimize environmental damage caused by materials used to print advertisements and propaganda messages. In this study, we use materials composite with natural and artificial fibers produced from raw materials present in nature, usually for various applications such as packaging, objects or even clothing. At this moment we are considering the possibility of a patent application, finding ourselves in the process of evaluating laboratory testing results, we can not assume an open position regarding the identification of the materials, its nature and production process. Therefore will be used acronyms in each material in this study:

Textile materials	Coating Materials	Composite Materials
Sample A	Sample 1	A1
Sample B	Sample 2	A2
Sample C		B1
Sample D		B2
Polyester		C1
		C2
		D1
		D2
		Polyester coated by PVC

Table 1: Materials and Correspondent Acronym

Attending to a later analysis, we decided not to include sample B on the final conclusions, because has a different *title* of the other samples on the study.

3.2. Analysis Experimental Method

Laboratory tests consisted on preparing samples to be subject of analysis and behavioural assessment, when exposed to similar conditions to those occurred during the period which the media are under environmental conditions. According to this, we did the following tests:

- Accelerated weathering chamber "QUV" by simulated exposure of the effects of degradation on the surface of materials caused by sunlight, heat and humidity.
- Quantification and analysis of colour degradation, measured on a spectrophotometer, based on measuring the difference in colour of the samples exposed in the QUV.
- Determination of the tensile strength and elongation at break and determination of the tear resistance performed in a dynamometer with constant stretch speed.

3.3. Accelerated Weathering

In QUV, according to Test Method 186 - 2001, Weather Resistance: UV Light and Moisture Exposure, we proceeded to eighteen cycles altering irradiance tests with condensing tests:

- 8h UV at an irradiance de 0,77W/ m², λ = 340nm at 45ºC.
- 4h condensation at 40ºC.

At the end of 1st, 3rd, 6th, 12th and 18th cycles, specimens were removed from each sample in order to check the colour degradation and tensile strength.

3.4. Colour Degradation Of Coating Films Under QUV Exposure

Regarding the evaluation of colour degradation, we only present the data related to the surface layer of the composite, therefore under sunlight exposure. We used specimens of sample 1, sample 2 and the polyester coated by PVC. The colour difference when compared with the undegraded was measured at three different points of each specimen. The results are shown in the table below.

	1st cycle	3rd cycle	6th cycle	12th cycle	18th cycle
1	3,016	3,225	3,021	3,052	3,156
2	2,26	2,521	3,057	3,021	3,048
Polyester coated by PVC	1,647	2,792	3,613	3,947	4,835

Table 2: Colour Degradation of the coated film samples under QUV exposure (CIE Lab)

We conclude the colour of the sample 1 degrades rapidly (more white), but then stabilizes. In sample 2 the variation of the colour degradation is similar to sample 1, but changes more slowly, only reaching the balance at 6th cycle. As for the polyester coated by PVC, degradation is constant (more yellow) showing no apparent tendency to stabilize.

3.5. Tensile Strength Of The Textiles Under QUV Weathering Degradation

We conducted tensile strength tests on a dynamometer, considering the elongation of the specimen at break, to check the maximum material strength and elongation at break time, according to standard NP EN ISO 13934-1:2001. To assess this, tests were conducted using five specimen of each sample A, B, C, D and polyester with 25mm wide by 150mm long, warp and weft directions, averaging the final result.

Test results of tensile strength (N) and elongation at break (mm) are presented in the following two tables respectively:

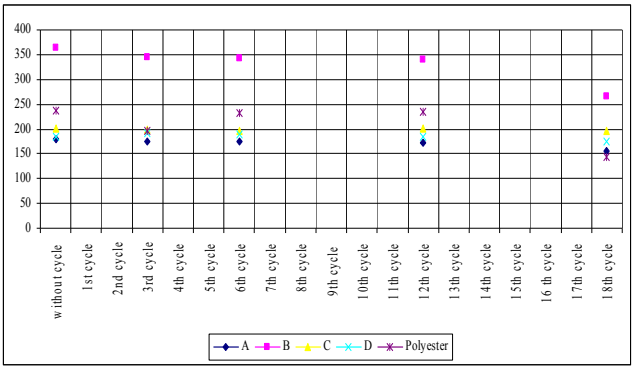
	A	B	C	D	Polyester
Without cycle	178,8	364,1	201,4	185,6	236,3
3rd cycle	175,7	343,74	198,2	192,47	196,1
6th cycle	175,53	341,47	197,6	189,5	233
12th cycle	173,33	341,2	200,1	183,27	235,8
18th cycle	156,73	266,4	197,4	174,6	143,7

Table 3: Tensile Strength at Break (N) of textile samples under QUV exposure

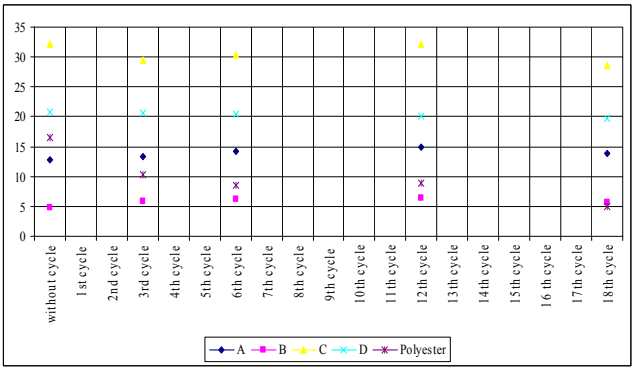
	A	B	C	D	Polyester
Without cycle	12,76	4,73	32,24	20,73	16,51
3rd cycle	13,26	5,83	29,56	20,67	10,27
6th cycle	14,3	6,27	30,39	20,35	8,56
12th cycle	14,93	6,42	32,08	19,99	8,82
18th cycle	13,93	5,6	28,64	19,75	4,92

Table 4: Elongation at Break (mm) of textile samples under QUV exposure

As mentioned before, sample B will not be part of the analysis. According to the final results of each sample, considering the maximum force, we find the sample with higher tensile strength is polyester, followed by samples C, D and A. However, concerning to elongation, the sample C appears first, followed by D, A and polyester.



Graph 2: Tensile Strength at Break (N) of textile samples under QUV exposure



Graph 3: Elongation at Break (mm) of textile samples under QUV exposure

Based on the results analysis, we found, as expected, the samples lose strength and elasticity during the eighteen cycles. In the tensile strength case, the damage is particularly noticeable from the 12th cycle. Regarding elongation, there is some stability, except polyester which reduces its elasticity gradually evident.

In conclusion, during the eighteen cycles, attending to the tensile strength, the sample C was the strongest one. However, regarding to elongation, the sample A was the lowest flexible. To the standpoint of billboards, the sample which showed most interesting features, as lower deformability of the advertisement elements, was A. The polyester sample was the one which degraded more.

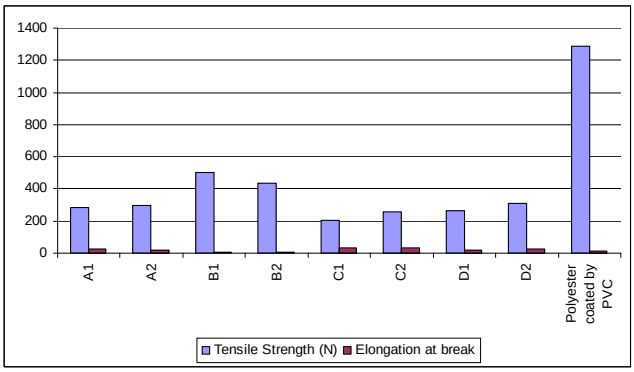
3.6. Tensile Strength And Elongation At Break Of The Coated Textiles

Similar to the procedure used for the previous test, we consider the elongation of the specimen at break, attending to confirm the maximum material strength and elongation at break, following now, the standard NP EN ISO 1421:2000. To do so, we used five specimens of each composite sample, with 30mm wide by 150mm long, warp and weft directions, not exposed under weathering accelerated.

For the reason that is a standard for coated fabrics or plastic rubber, we consider the samples A, B, C and D samples coated by 1 and 2; in other words, the sample A was coated by sample 1 on both sides (A1), sample A was coated by sample 2 on both sides (A2), using the same procedure for the remaining samples, B1, B2, C1, C2, D1 e D2. Also using polyester coated by PVC.

Sample	Tensile Strength (N)	Elongation at break
A1	285,2	26,66
A2	295,2	16,74
B1	504	8,41
B2	438,25	6,41
C1	205,8	30,44
C2	254,8	30,89
D1	261,2	22,53
D2	310,4	26,16
Polyester coated by PVC	1286	15,2

Table 5: Tensile Strength (N) e Elongation at Break (mm) of coated textile samples



Graph 4: Tensile Strength (N) e Elongation at Break (mm) of coated textile samples

If we look to the results, we found a higher tensile strength, on those samples which are coated with the sample 2. In general, polyester coated by PVC reveals a much higher performance than the other samples. If we consider only the tensile strength, the sample D2 shows the highest amount, among the samples which proved to be biodegradable. If we consider only the elongation at break, the composite which showed the lowest value, or less elasticity, was the A2. Attending to this reason and because the purpose of this kind of material is to be used as advertising media, A2 was the sample which revealed the most interesting performance, taking in consideration its lowest elongation and its close results of tensile strength to D2. Indeed, having high flexibility reveals a negative issue for the materials used as media for outdoor advertising, given the possible of deformations and ruptures occurred in the elements of the advertising and propaganda messages.

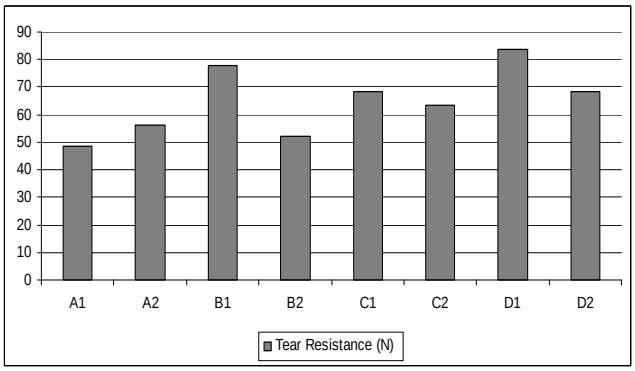
As we expected, the influence of the substrate is higher than the coating, regarding to tensile strength of coated textiles.

3.7. Tear Resistance Of Coated Textiles

For the following test, was used the method of tear-shaped tongue, as described in standard NP EN ISO 4674-1: 2005. The results indicate the necessary forces to initiate and propagate the tear of a coated textile to a constant speed. We used five specimens of each sample, with 200mm long by 150mm wide, we cut a lounge with 100mm x 50mm, as illustrate in the standard (these samples were not expose to accelerated weathering conditions). Because is a standard for coated fabrics to plastic or rubber, we consider the samples A, B and C coated by samples 1 and 2, using the same procedure as in the previous test.

Sample	Tear Resistance (N)
A1	48,48
A2	56,18
B1	77,79
B2	52,4
C1	68,4
C2	63,32
D1	83,73
D2	68,38

Table 6: Tear Resistance (N) of textile coated samples



Graph 5: Tear Resistance (N) of textile coated samples

According to the results, we found coated textile by sample 1 are more resistant to tearing, except for sample A. In general, considering a situation of tear from an initial cut, D1 is the most resistant, followed by C1 and D2.

3.8. Composting Behaviour Of Coated Textile

As mentioned before, the composite materials used for the tests are made by natural and artificial fibers and films. To confirm we submit samples A1, A2, C1, C2, D1 and D2, to composting. The purpose of the experiment was to evaluate the results in order to observe and understand the process of evolution in a non-laboratory environment of the composites under study. The methodology based on information about home composting from the Cornell Waste Management Institute. For this test, was used a composting deposit with 610x610x830mm, fulfilling three conditions: enough oxygen and heat and adequate moisture. Were selected organic materials that can be composted, usually classified as *brown materials* (hay, straw, small twigs) and *green waste* (some vegetables such as lettuce and cabbage variety).

The materials were placed in layers, always considering the following procedure: on the bottom of the composter, thick branches arranged randomly, followed by brown materials, green waste, brown materials, green waste, consecutively in that order, leaving brown materials for the last layer. Note that each layer was sprayed with water to maintain the proper moisture content. When we had enough compost, test samples were introduced between green waste, pack as follows: layer of brown materials, compost, green waste, test sample, green waste, compost and finally brown materials, always maintaining an appropriate moisture content. Weekly, we proceeded to the observation, analysis and evaluation of materials under study. Fortnightly or weekly, case needed, was taken a sample of each material.

The following table shows the evolution of the samples degradation. First is shown before undergoing in the action of the composter, followed by the 1st, 3rd, 6th, 12th and 15th weeks in the composter:

	A1	A2	C1	C2	D1	D2
0						
1st						
3rd						
6th						
9th						
12th						
14th		Not rated	Not rated	Not rated	Not rated	Not rated
15th	No trace	Not rated	Not rated	Not rated	Not rated	Not rated

Table 7: Composting of coated textile samples

We noticed that samples A1 and A2 degrade faster than the other samples placed in the composter. In this perspective, the coating begins to suffer deterioration from the 2nd week, more obvious after six weeks, when begins to separate from the substrate. At 8th week of composting, the sample begins to lose strength at weft, this is shown by the opening of cracks, becoming more noticeable at 10th week, when the weft degradation is almost complete, make the sample handling very difficult. Between the 11th and 14th weeks the warp loses strength, closing the action of micro organisms, bacteria and fungi by the transformation of the sample into organic compost.

3.9. Digital Printing Tests

The samples in study were also tested for printing, using the same technology applied for wide format printing of polyester coated by PVC. Tests were performed by an

inkjet printer which uses UV curable ink. In other words, ink is formulated to dry (cure) through activation of ultraviolet radiation. This process has proved to be more environmentally friendly, given by the absence of volatile organic compounds (VOC) and reduced ink consumption by m², thus less waste.

Below are presented images related to the digital printing of coating films and also polyester coated by PVC.

 Digital printing	 Polyester coated by PVC printed
 Sample 1 printed	 Sample 2 printed

Table 8: Digital Printing on the biodegradable media and polyester coated by PVC

The print quality was quite satisfactory, considering the high colour contrast and elements definition and good material behaviour.

4. CONCLUSION

Attending to the high environmental impact and consequent harm to human health caused by current media outdoor advertising, in particular polyester coated by PVC, we proposed to develop a biodegradable solution able to minimize or totally eliminate this problem.

A previous study related to the reducing effects of the printing area of sixteen billboards was conducted, based on the colour change of some graphic elements. Attending to the negative effects related to the chemical composition of inks used to print large format, we found that it was possible a decrease of 75% of the print area without affecting significantly the content of the communication message on the advertisement.

Related to the development of a biodegradable support, according to current legislation about display of advertising and propaganda messages, the results of the laboratory tests of each sample under study, showed that after eighteen cycles of exposure to weathering accelerated QUV equipment, samples 1 and 2 turned more white in a similar way at the end of eighteen cycles, although the sample 1 rapidly become stable, while the sample 2 only reach it at 6th cycle. As for the polyester coated by PVC, presents a continuous trend for yellowing.

Regarding tests according to standard NP EN ISO 13934-1:2001, sample C showed higher tensile strength at break (among the materials that proved to be biodegradable), however revealed a high elongation, so the sample which has demonstrated more classifiable for print advertising was sample A, considering its lowest elongation. The polyester sample had more degradation effects.

Considering the maximum force and elongation at break of the composite materials, according to standard NP EN ISO 1421:2000, we found that the textiles coated by sample 2 generally show greater resistance than those coated with sample 1. The behaviour of elongation depends on the substrate sample. The sample A2 was the one which revealed a more interesting behaviour, considering the lower elongation and tensile strength amounts close to D2. The traditional polyester coated by PVC revealed high tensile strength and reasonable resistance to deformation. Regarding to tear resistance, the sample which showed the best performance was D1.

Degradation composting tests showed that the composites when exposed to the action of micro organisms become an integrate part of the organic matter surrounding them about the 14th week.

Attending to: low elasticity (16,74mm compared with 15,2mm of polyester coated by PVC), a fundamental feature of media for printing advertising and propaganda messages, a reasonably high tensile strength (295,2N to 310,4N for the sample more resistant) and fast degradation by composting, the sample A2 showed the best performance.

Finally, for the digital printing tests was used environmental friendly equipment, achieving interesting results, fundamental in the advertising field: high colour

contrast and elements definition and good material behaviour.

The results of this study will provide valuable information for the development of an environmentally friendly solution thus according to the regulation and Portuguese law.

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AUTHORS BIOGRAPHIES

FERNANDA VIANA concludes her degree in Advertising Engineering in 2003 and her master degree in Communication Sciences in 2009 both at University Fernando Pessoa (UFP). She works in the graphic design, advertising and marketing fields, teaches at UFP and she is also a member of several research groups, including a multidisciplinary one focusing billboard. Her email address is: fviana.fv@gmail.com

JORGE NEVES concludes his degree in Chemical Engineering at Engineering School of University of Porto, followed by his master degree in Textile Technology and his PhD in Textile Engineering (Textile Chemical) at University of Minho (UM). Since 1984 has been Professor at UM. He's member of Research Centre of Excellence 2C2T at UM and he's part of several international research projects. He has a substantial number of publications (about 100) among books, chapters, patents, articles and communications. His email address is jgneves@det.uminho.pt