

Chemical Flexi Not-So-Fantastic : A review on How the Versatile Material Harms the Environment and Human Health

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ABSTRACT

The review presented in this paper focuses on flex's impact on Human health and environment. The flex banners are made of poly-vinyl chloride. It causes a serious threat to the environment, as it is not bio-degradable. Flex cannot be re-used or recycled. Made of synthetic polymer, it has to be burnt. When burnt, they emit toxic fumes that have serious effects on health. It can cause cancer and infertility. The toxins released when the flex banners are burnt are carcinogenic (any substance, radionuclide, or radiation that is an agent directly involved in causing cancer. This may be due to the ability to damage the genome or to the disruption of cellular metabolic processes. Burning of flexi releases harmful pollutants like sulphates and nitrates. These pollutants are heavier than air and form a thick blanket reducing the supply of oxygen in the vicinity. PVC leaches out slowly into the soil and pollutes it. Usage of cloth banners could be encouraged as it would not only give a livelihood for painters and labourers, but also would not cause any environmental degradation. The purpose of this review is to 100% Environment-friendly Polyethylene Flexi banner materials must be developed and encouraged to the environmental sustainability.

Keywords: Flex Banners, Poly-Vinyl Chloride, Polyethylene, Cancer and Infertility.

I. INTRODUCTION

Visual pollution is the unattractive and man-made visual elements of a vista, a landscape, or any other feature that we may feel uncomfortable looking at. It can be caused not only by (giant) billboards, business signs, street signs, telephone and utility poles, electricity wires but also garbage (think littered beaches, rivers, roadsides, or overflowing garbage containers, plastic stuck in fences or trees, a pile of cigarette butts outside bars, clubs or on beaches), open-pit mines, dog poo, rubbish dumps, mobile phone towers [1].

Visual pollution can be present in any area from the home to a hectic city street. It can be bad shadow on a television camera, or it can be a large pile of trash on the side of the road that interrupts the view of nearby mountains. Visual pollution is dependent on the person and the situation. For example, one person may not mind seeing a city street lined with thousands of billboards

and advertisements, while another person may be bothered by this sight and may prefer to look at an uncluttered country road. Depending on the situation, it can be hazardous to drivers and other people. A building that is made entirely of glass can reflect sunlight, creating visual pollution for the people driving by the building. Billboards and advertisements on highway roads can be a visual pollution issue that causes drivers to become distracted while traveling on roadways. These distractions and issues can be fatal and can lead to automobile accidents as a result of the seconds it takes to look at a billboard [2-3].

Flex banner printing is widely used these days in almost all kind of small budget events. We are also witnessing flex banner being used in events like birthday parties and maturity functions. Flex printing future is on rise in almost all cities in India may it be Hyderabad, Mumbai, Delhi, Chennai, Kolkata, and find them even in villages. Earlier flex printing was confined only to the banner printing for political parties at the time of election but

everyday hundreds of modern water proof flex boards and banners mushroom using for several causes and reasons. Interestingly, most of them are from the leaders of the ruling front, conveying their personal achievements or to send seasonal and festival wishes to the public. Taking the cue fan clubs of movie stars are constantly vying for public attention by hoisting huge cut-outs and posters. Generally Flex banner is relatively cheaper as compared to other medium of printing. It is stretchable as well which multiply its use. But owing to the advantages, the printers prefer flex over cloth banners. Unlike cloth, we can generate high quality desired graphics and designs on flex in a very short span of time. Also the output quality would be superior and the material is durable. Flex is quite similar to plastic. Though it has many advantages over cloth, it is highly hazardous and it can cause imbalance to the natural ecosystem. We are protesting right from the beginning and to save our ecology this should be banned. Plastic or flex by itself is not harmful. The problem begins when they are not recycled. They can choke the earth or clog the drain and when burnt, can release toxic fumes. Incineration (burning at very high temperature) is an option but it can be expensive though we can look at options to do it on a large scale. Flex banners deliver high-quality digital prints, but they are not biodegradable and when they burn, they emit toxic fumes that have serious effects on health. The toxins released when the flex banners are burnt are carcinogenic. The flex banners are made of Poly Vinyl Chloride (PVC) which is non-biodegradable [4-5]. When burnt they release gases that are harmful, cause cancer and infertility. The PVC requires a temperature of 299 degree Celsius to burn the flexi and it also raises the temperature of the surroundings. According to experts, the burning of flexes releases harmful pollutants like sulphates and nitrates. These pollutants are heavier than air and form a thick blanket reducing the supply of oxygen in the vicinity.

Since burning flex is a cheap option, many do so without considering the harmful results Environment is not a priority for either the people or the government and suggests that we can use flex made of starch (it helps in degradation), though it may not be a very durable option. As the country seems to have no control over usage of flex banners, their numbers are increasing by the day and could easily be estimated to be a few lakhs. The

numbers are now on the rise, what with the elections just around the corner. Since these banners deliver high-quality digital prints, they are much in demand but the realisation that they are not bio-degradable and emit toxic fumes that have serious effects on health when burnt is hardly being propagated. The toxins released when the flex banners are burnt are carcinogenic. Recycling post-consumer PVC is difficult [6-7].

II. METHODS AND MATERIAL

Types of Banners printing materials

1. Cloth banner :- Cloth banners are employed in Tier 1 and Tier 2 cities but it is being fast replaced by flex as flex printing machine are not that costly and are readily available everywhere. Wrinkle-Free Fabric Banners & Backdrop Printing - Now Dye Sublimated! Durable 100% polyester woven fabric offers a great substitute for canvas with the print performance of vinyl. Fabric Banners can also be folded and stored eliminating the need for banner tubes. Our dye sublimated fabric is a three layered woven fabric that is 100% Polyester. This fabric is wrinkle resistant with minimal light reflection and now, washable! The minimal space between threads on this fabric allows for exceptional print quality and opacity, more than other standard fabrics. Fabric is suitable for table tops, photo backdrops, and elegant pop displays.
2. Flex banners:- Flex banners are omnipresent and there are few printers who print only a minimum 100 sq ft of flex else they charged exorbitantly for lesser quantity like even a flex which is 1ft x 1ft will cost minimum 3 sq ft as flex comes in roles with fix width which is minimum 3 ft.
3. Star Flex banners:- If your design art work has background color, text color, logo, picture and images then you need to choose star flex instead of normal flex as star flex prints color better than flex. Not Just "Recyclable" Banners But "Already Recycled" Banners Known as the manufacturer of supreme quality Coated and Laminated banners, Star flex is proud of launching a recycled banner range -starflex@discovery Media. No compromise on its performance in printing quality & resistance, but its dedication to the environment is unique. With 50% less consumption of new PVC

resin in the final banner product, it allows less new PVC production, less consumption of Oil, less emission of gas, less production of by-chemicals, more energy saving, but also less after-use-period PVC banners in the landfilling or incineration. The front printing side is Star flex standard white film, using 100% virgin new PVC.

4. Vinyl banners: - Vinyl material is non-stretchable and better quality material as compared to flex material and can be used both indoors and outdoors for different event banner printing. Same rates are for both vinyl without sticker also called self-adhesive sticker and without sticker. Vinyl banners today have gained a lot of popularity as an effective corporate marketing tool, primarily because of its versatile and sturdy nature. According to printing consultants and experts at Documedia online printing services, the sturdy nature of the material is what makes it usable in various forms – vinyl banners can be connected, hung or mounted in a number of ways. Another one of the major benefits of using vinyl banners is that they can be used both indoors as well as outdoors quite effectively because of its durability. Here in this article we will take a look at the various types of vinyl used for printing banners.
 - a) Vinyl Banner Printing: Vinyl Options; Here are the various types of vinyl used for vinyl banner printing -
 - b) Scrim Vinyl - This type of vinyl is known for its durability and strength which makes it a great option for outdoor applications.
 - c) Gloss Vinyl – This kind of vinyl is used for multi coloured vibrant images and pictures which require a glossy surface. Glossy vinyl can be used for a wide range of banner applications and is ideal for usage in various weather conditions.
 - d) Matte Vinyl - This type of vinyl has a glare and water resistant coating which allows for vibrant and beautiful images.
 - e) Blackout Vinyl - Blackout vinyl as the name suggests has a black vinyl layer enclosed in between the two outer layers of vinyl.
 - f) Mesh Vinyl – Mesh vinyl is quite similar to conventional vinyl. However, mesh vinyl banners are capable of enduring harsher weather conditions as compared to conventional vinyl.

5. Eco solvent material:- Eco solvent vinyl is used for indoor shop banners, at hotels for indoor events and exhibition and are pasted on the foam surface, pasted on plastic frame or, wooden frame. Eco Solvent inks provide several benefits for consumers seeking a sustainable solution to high resolution printing and have increased greatly in popularity in recent years. These inks are highly durable, environmentally friendly and available in a wide variety of colors. Below are some key benefits to using eco solvent ink.
 - a) Eco Friendly (compared to heavy solvent inks): Heavy solvent inks are typically not ideal for use in printing areas with minimal air flow, due to the fumes and odours they produce. Eco Solvent inks, on the other hand, do not produce fumes and are generally regarded to be friendly to the environment by comparison.
 - b) Ideal for billboards and other forms of outdoor signage: Eco Solvent ink is highly durable and adheres well to both coated and uncoated surfaces, producing high resolution images that are ideal for billboards and other forms of outdoor signage [8,9,10].

2.1 The harms of Flex

- a) Almost all hoardings contain flex -- a material that damages environment and is a risk to health. The flex banners are made of poly-vinyl chloride. It causes a serious threat to the environment, as it is not bio-degradable.
- b) Flex cannot be re-used or recycled. Made of synthetic polymer, it has to be burnt. When burnt, they emit toxic fumes that have serious effects on health. It can cause cancer and infertility.
- c) The toxins released when the flex banners are burnt are carcinogenic (any substance, radionuclide, or radiation that is an agent directly involved in causing cancer. This may be due to the ability to damage the genome or to the disruption of cellular metabolic processes.)
- d) Polyvinyl chloride or 'PVC' leaches out slowly into the soil and pollutes it.
- e) Experts say flex is dangerous because it doesn't dissolve on its own.
- f) Usage of cloth banners could be encouraged as it would not only give a livelihood for painters and

labourers, but also would not cause any environmental degradation [11].

2.2 Associated Materials in Ink used in flex Production

These compounds include styrene acrylate copolymer, polymethyl methacrylate (PMMA), iron oxide, amorphous silica, carbon black, paraffin wax, diethylene glycol, and 2-pyrrolidone. Each of these compounds is made by the chemical industry and each compound's use in flex printing. They are also synthesized differently with varying energy inputs as well as associated by products and waste. First, we will give an overview of the synthesis of the primary compounds used in flex printing; their health and environmental effects will be discussed in later sections of this report [12].

2.3 Styrene Acrylate

Styrene acrylate copolymer makes up approximately 80% of the mixture that is used in flex printing. The chemical formulas of the bases styrene and acrylate to make the numerous trade secret polymers are respectively $C_6H_5CH=CH_2$ and $CH_2=CHCOO$. The styrene base is made via steam cracking of ethane. Ethane (C_2H_6) is a derivative hydrocarbon of natural gas. The product of ethane cracking is ethylene which is one component of ethylbenzene ($C_6H_5CH_2CH_3$). Once ethylbenzene has been made, it then can be converted into styrene. There are many different hydrocarbons by products that are made during this process which are used themselves as energy inputs for the synthesis process. Thus the total process is considered to be very efficient with a production yield of 97% [13].

2.4 Carbon Black

It is used in flex printing as a key pigment. The synthesis of carbon black is an energy intensive process as it requires burning hydrocarbons at extremely high temperatures –approximately 2000 degrees Celsius –in order to obtain elemental carbon. The feedstock hydrocarbon can come from tar, coal tar, ethylene cracking tar, and a small amount from vegetable oil. Each of these sources has a high carbon to hydrogen ratio. Burning a secondary feedstock of natural gas creates a superheated air stream which vaporizes and pyrolyzes the primary carbon black feedstock resulting

in elemental carbon. The suspended carbon black is then removed from the air stream and condensed into pellets to be used in various applications, with one of the main applications being pigments for ink and toner. The emissions from this process mainly come from the superheated air stream and include CO_2 , H_2O , N_2 , NO_x , SO_x , VOCs, and significant amounts of particulate matter from reducing the primary feedstock [14].

Carbon black is the most dangerous compound that the plant workers handle. Carbon black is produced by incomplete combustion of gaseous or liquid hydrocarbons. Workers collect this leftover powder and process the powder either into a liquid for inks or a more condensed powdered form for toners. Before the carbon black is processed to make the ink or toner, the compound is in an unbound state. The unbound state of carbon black is the most harmful to human health and the EPA and numerous health institutes have classified it as a Class 2B carcinogen if a person is chronically inhaling the substance. Unbound carbon black has been linked to several cancers such as breast, throat, lung, and liver cancer. In its bound state, carbon black is significantly less toxic, causing mild nose and throat irritation if constantly inhaled. If leaked into water sheds carbon black can also act as an endocrine disruptor. It does not dissolve in water and researchers for the chemical company Rohm and Haas in California observed the effects of carbon black via a compound called Thixon on rainbow trout. Thixon is an adhesive agent that is largely composed of carbon black. The researchers found an increase in reproductive disorders such as developmental mutations and increased transgender populations [15].

2.5 Paraffin Wax

It is used in the xerographic process to provide a medium to fuse the toner onto the paper with the help of heat from the printing device. Paraffin wax is a by-product of the refining of coal and oil. It is either a colorless or white, in some cases translucent, wax composed of solid straight chain hydrocarbons. It is obtained from either petroleum by de waxing light lubricating oils, or from coal gas via the Fischer-Tropsch reaction which converts a mixture of carbon monoxide and hydrogen into liquid hydrocarbons. This process creates various hydrocarbons that have other uses for

industry .Paraffin wax is petroleum based wax and is an ingredient found in both toner and ink. Paraffin Wax is regarded to be fairly safe in its solid form, however there are many toxic chemicals released if the wax is melted or burned. These chemicals include toluene, formaldehyde, benzene, methyl ethyl ketone, and particulate matter. For example formaldehyde, benzene and toluene can cause major respiratory problems such as nose and throat irritation and acute bronchitis. Specifically, these carcinogens have been linked to breast and throat cancers .As long as paraffin wax is not lit on fire, the environmental impacts are low. When the wax is burning, it releases many toxic and/or carcinogenic substances as well as small amounts of carbon dioxide and methane which are greenhouse gases [16].

2.6 Polyvinyl Chloride, or 'PVC'

It is one of the most widely used polymers in the world. Due to its highly versatile nature, PVC is used extensively in many industries including construction, automotive, electronics, packaging, fashion and design amongst others. However once it enters the waste stream, it has traditionally been seen as a cause of harmful emissions from incineration.

2.6.1. Chemical reactions

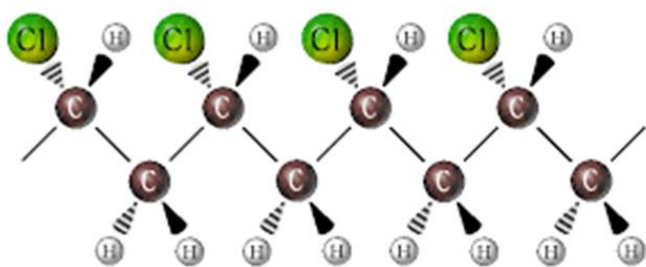


Figure 1: Structure of Polyvinyl chloride, or 'PVC'

This focus on PVC was due to the presence of chlorine, which leads to the production of dioxins, the emission of HCl and the production of solid hazardous waste because of the presence of heavy metals from the additives used in various formulations. Polyvinyl chloride contains significant quantities of chlorine (up to >50%) and so one of the main products of combustion is hydrochloric acid (HCl)

Solid polyvinyl chloride (PVC) plastic first melts with increasing temperature, then at a certain point the

polymer structure starts to unzip. Next the chlorine and hydrogen start to be released (forming HCl) . If there is sufficient oxygen around the carbon oxidizes and forms carbon dioxide (CO₂) and some carbon monoxide (CO) . Soot formation happens when there is insufficient oxygen for ideal combustion and so the carbon concentrates into joined aromatic rings (polycyclic aromatic hydrocarbons PAH's) and ultimately into elemental carbon (carbon with no hydrogen or oxygen).The presence of chlorine complicates matters and with some oxygen present, dioxins & furans will form. The air that gets involved with combustion beside supplying oxygen also has nitrogen (78%), at high temperatures nitrogen compounds begin to form (nitrogen oxides (NO_x) and hydrogen cyanide (HCN).As the hydrocarbon base starts to lose hydrogen, the carbon begins to form more concentrated carbon molecules (aromatic hydrocarbons such as benzene [17-18].

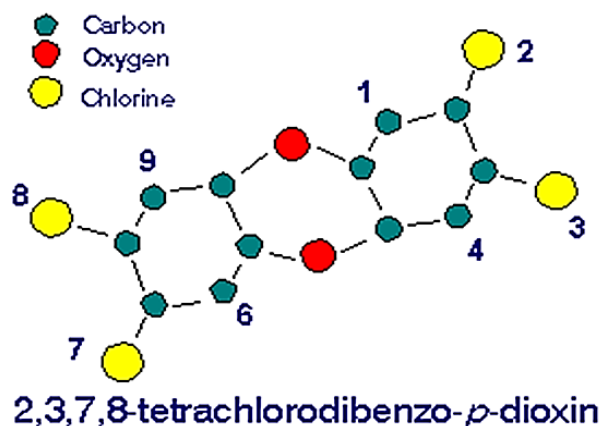
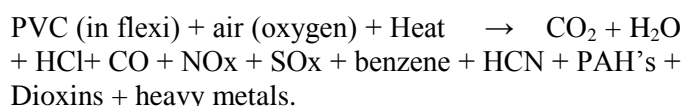


Figure 2: Structure of Dioxins (Polychlorinated dibenzodioxins)

Table 1. Measurement of hazardous chemicals released from flexi at fire [18]

Exposure	concentration	Environmental standard
Benzene	0.26 ppm	0.0001 ppm
Hydrogen chloride	0.62 ppm	0.067 ppm
PAH's (as B[α]P)	0.5-1.0 ng/m ³	1.5 ng/m ³
Dioxins/furans (as TEQ)	2.8-19.3 pg/m ³	5.0 pg/m ³
Lead	10.1 μg/m ³	2.0 μg/m ³
Chromium	5.7 μg/m ³	1.5 μg/m ³
Nickel	6.4 μg/m ³	2.0 μg/m ³

Among all other chemicals, Dioxins, are toxic, persistent, and bio accumulative chemical that was found in the environment- including air, water and soil- in amounts sufficient to result in adverse health and environmental effects. Dioxins are the one of the by-products of the combustion of flexi, Dioxin is a known human carcinogen and the most potent synthetic carcinogen ever tested in laboratory animals. A characterization by the National Institute of Standards and Technology of cancer causing potential evaluated dioxin as over 10,000 times more potent than the next highest chemical (diethanol amine), half a million times more than arsenic and a million or more times greater than all others. Chemicals added to plastics are absorbed by human bodies. Some of these compounds have been found to alter hormones or have other potential human health effects [19, 20].

2.7 Impacts on Environment

Plastics used in flex are very long-lived products that could potentially have service over decades, and yet our main use of these lightweight, inexpensive materials are as single-use items that will go to the garbage dump within a year, where they'll persist for centuries. Different types of synthetic Materials used in the flex making have always sows adverse impact on nature and the atmosphere. More recent uses synthetic materials those more and more man-made synthetic colours could in their life-time enter our atmosphere, soil or water environments (causes the water and soil pollution. The risk of synthetic coloured Materials entering these environments, as well as the effects on human health from people having contact with the flex, needs to be assessed and researched in the following areas:-

1. The detection of the particles in the environment
2. The measurement of emissions of flex
3. The life-cycle of the particles in the environment
4. The toxicity of the particles to the environment
5. The impact on the immediate and longer range environment

We've researched the environmental impact of printing and what we have found is quite shocking. Here are some facts about the shadier side of ink and toner:

- Ink cartridges in landfills can take up to a millennium to decompose, as they contain resin
- Toner cartridges contain toxic ingredients such as volatile organic compounds in the form of solvents
- It takes almost a gallon of oil to make a single laser ink cartridge
- Manufacturing a single toner cartridge releases 4.8 Kilograms of carbon dioxide into the atmosphere

Despite digitization movements and eco-friendly programs, printing continues in the world increasing rates. To help offset the negative impact of printing, companies and individuals can use Dimples to reduce the amount of ink and toner used in printing over 30%. Using a third less ink means lessening the environmental impact from ink and toner by a third [21-22] .

2.8 Global Warming

The pollutants that contribute to global warming are commonly known as greenhouse gas emissions. Carbon dioxide is probably the best known greenhouse gas, but methane, nitrous oxide and fluorinated gases also play a role in driving climate change. Human activities that cause global warming pollution can be best understand by examining the various sources of each type of greenhouse gas. Carbon dioxide represents 85 percent of all greenhouse gas emissions emitted from human sources. Globally, the largest source of carbon emissions is the combustion of fossil fuels like coal, natural gas and oil for energy. Electricity production is the single biggest generator of carbon. Carbon dioxide is also emitted naturally by animal and plant respiration, including humans [23].

Apart from that, PVC is used extensively in many industries including construction, automotive, electronics, packaging, fashion, and design amongst others and especially used in flex making. All commercial organic polymers will degrade in air when exposed to sunlight, although there is a very wide range of photo-oxidative susceptibilities. It is usually the absorption of near ultraviolet (UV) wavelengths which leads to bond-breaking reactions and the concomitant loss of useful physical properties and/or discoloration .Exposure to sunlight can have adverse effects on the useful great interest of plastic products. Ultraviolet (UV)

radiation can break down the chemical bonds in a polymer. Photo-degradation causes cracking, chalking, color changes and the loss of physical properties [24].

The flex which are made of with PVC plastic and synthetic colours are not ecofriendly. Where we find flexes are more, the temperature of particular atmosphere is high due to reflection of incident sunrays on flex. The chemicals used in the flex are easily entered in to the soil and cause the ground water pollution. Flex banners deliver high-quality digital prints, but they are not bio-degradable and when they burn, they emit toxic fumes with bad odour (causes the air pollution) that have serious effects on Environment

Solid polyvinyl chloride (PVC) plastic first melts with increasing temperature, then at a certain point the polymer structure starts to unzip. Next the chlorine and hydrogen start to be released (forming HCl) . If there is sufficient oxygen around the carbon oxidizes and forms

carbon dioxide (CO₂) and some carbon monoxide (CO) which causes global warming [25] .



2.9 Health effects in humans

In addition to cancer, exposure to dioxin can also cause severe reproductive and developmental problems (at levels 100 times lower than those associated with its cancer causing effects). Dioxin is well-known for its ability to damage the immune system and interfere with hormonal systems. Dioxin exposure has been linked to birth defects, inability to maintain pregnancy, decreased fertility, reduced sperm counts, endometriosis, diabetes, learning disabilities, immune system suppression, lung problems, skin disorders, lowered testosterone levels and much more.

Table 2: Plastics used in making flex and their Adverse Health Effects [26 and 27]

Plastic	Common Uses	Adverse Health Effects
Polyvinylchloride	Food packaging, plastic wrap, containers for toiletries, cosmetics, crib bumpers, floor tiles, pacifiers, shower curtains, toys, water pipes, garden hoses, auto upholstery, inflatable swimming pools and making flex	Can cause cancer, birth defects, genetic changes, chronic bronchitis, ulcers, skin diseases, deafness, vision failure, indigestion, and liver dysfunction
Phthalates (DEHP, DINP, and others)	Softened vinyl products manufactured with phthalates include vinyl clothing, emulsion paint, footwear, printing inks, non-mouthing toys and children's products, product packaging and food wrap, vinyl flooring, blood bags and tubing, IV containers and components, surgical gloves, breathing tubes, general purpose labware, inhalation masks, many other medical devices and making flex	Endocrine disruption, linked to asthma, developmental and reproductive effects. Medical waste with PVC and phthalates is regularly incinerated causing public health effects from the release of dioxins and mercury, including cancer, birth defects, hormonal changes, declining sperm counts, infertility, endometriosis, and immune system impairment.
Polycarbonate, with Bisphenol	Water bottles and making flex	Scientists have linked very low doses of bisphenol A exposure to cancers, impaired immune function, early onset of puberty, obesity, diabetes, and hyperactivity, among other problems (Environment California)
Polystyrene	Many food containers for meats, fish, cheeses, yogurt, foam and clear clamshell containers, foam and rigid plates, clear bakery containers, packaging "peanuts", foam packaging, audio cassette housings, CD cases, disposable cutlery, building insulation, flotation devices, ice buckets, wall tile, paints, serving trays, throw-away hot drink cups, toys and making flex	Can irritate eyes, nose and throat and can cause dizziness and unconsciousness. Migrates into food and stores in body fat. Elevated rates of lymphatic and hematopoietic cancers for workers.
Polyethylene	Water and soda bottles, carpet fiber, chewing gum, coffee stirrers, drinking glasses, food containers and wrappers, heat-sealed plastic packaging, kitchenware, plastic bags, squeeze bottles, toys and making flex	Suspected human carcinogen
Polyester	Bedding, clothing, disposable diapers, food packaging, tampons, upholstery and making flex	Can cause eye and respiratory-tract irritation and acute skin rashes
Urea-formaldehyde	Particle board, plywood, building insulation, fabric finishes and making flex	Formaldehyde is a suspected carcinogen and has been shown to cause birth defects and genetic changes. Inhaling formaldehyde can cause cough, swelling of the throat, watery eyes, breathing problems, headaches, rashes, tiredness

Polyurethane Foam	Cushions, mattresses, pillows and making flex	Bronchitis, coughing, skin and eye problems. Can release toluene diisocyanate which can produce severe lung problems
Acrylic	Clothing, blankets, carpets made from acrylic fibers, adhesives, contact lenses, dentures, floor waxes, food preparation equipment, disposable diapers, sanitary napkins, paints and making flex	Can cause breathing difficulties, vomiting, diarrhea, nausea, weakness, headache and fatigue
Tetrafluoro-ethylene	Non-stick coating on cookware, clothes irons, ironing board covers, plumbing and tools and making flex	Can irritate eyes, nose and throat and can cause breathing difficulties

2.9.1 Management practices in controlling plastic usage and ink usage in flex making:

Only 5% of the world's plastic is recycled and the remaining 96% ends up in landfills, or even worse, as litter or in the oceans. But one can and one has to, reduce its use, and reduce the impact it has on the environment. There are several aspects to this effort and can make a good start by following the basic environmental edicts: Reduce, Reuse, and Recycle [28].

Based on the review done on the environmental and human health effects of Synthetic and traditional inks used in flex making, as well as the research done on new technologies, we propose several recommendations to reduce visual pollution. The best option for is to start purchasing ink that is more environmentally friendly. There are several options for eco-purchasing, one of the best options being soy-based inks. This reduces the amount of chemicals in the toners as well as the health effects to the manufacture workers and environmental effects of producing and disposing of the toner cartridges. Another option for eco-purchasing is to buy solid ink compatible devices. Solid ink is vastly more environmentally friendly than traditional inks. Solid ink is made from cleaner burning waxes than the paraffin waxes in inks used in flex making [29-32].

III. CONCLUSION

1. Green is the new black! Green cars, green shoes, green bags, green hair, green beer, green food, Green energy, green people, green printing and green everything... green is poised to become the most favoured colour of the century! The human race suddenly became greenophilic when exposed to an imminent horror of total extinction. And it is a pity that we took so long to realize the consequences

of our reckless lifestyle - depleting the natural resources and contaminating the earth.

2. Plastics used in flex offer considerable benefits for the future, but it is evident that our current approaches to making, use and disposal are not sustainable and present concerns for environment and human health. Set an example to others and encourage them to help. They are useful and popular materials which can be produced with relatively little damage to the environment. The problem is the excessive use of plastics in flex in one-off applications together with careless disposal.
3. Unfortunately, it seems that nobody, even the authorities or the public are bothered about the flex or its impact on the environment. To an extent, the country dwellers are also quite engrossed in the visual explosion created by these huge hoardings. While traffic pollution, noise pollution have become constant subjects of discussion, visual pollution is one such that doesn't get much attention. The visual pollution refers to anything like banners, huge cut outs and flexes hoardings that would hamper the visual beauty, affect the environment and sometimes even pose threat to life. Some billboards are obscene and these banners are found at vantage points in the country – sometimes even distracting motorists. In some place, even footpaths have not been spared and this causes huge inconvenience to pedestrians. Accidents due to any of these cannot even be identified.
4. Another avenue to develop for reduction of flex usage by media people, politicians, faculty, staff and students, and all other individuals, is to increase awareness of flex usage and the associated health and environmental effects. To this end, the most impressive points of our findings could be converted into education and outreach campaigns for behavioural change. The health and environmental effects of flex usage is another area full of potentially shocking information that could

encourage environmentally concerned individuals to reduce flex making. Several systems are already available in the industry to support environmentally-friendly printing. We can call these systems Green Printing Agents (GPAs) as they assist in the transition to Green Printing. But there lies the big stumbling block as green printing comes with additional investments! Days are gone when one can take such technologies as a luxury... now they became a necessity.

5. Usage of cloth banners could be encouraged as it would not only give a livelihood for painters and labourers, but also would not cause any environmental degradation. 100% Environment-friendly Polyethylene Flex banner materials must be developed and encouraged to the environmental sustainability.

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