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International Journal of Current Research
Vol. 9, Issue, 07, pp.54349-54359, July, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EFFECT OF POST-CONSUMER PRODUCTS AND WASTE ON HUMAN HEALTH AND THE ENVIRONMENT, IN COLOMBIA

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ARTICLE INFO

Article History:
Received 14th April, 2017
Received in revised form
25th May, 2017
Accepted 11th June, 2017
Published online 31st July, 2017

Key words:
Post-consumer waste,
Heavy metals,
Environment,
Human health.

ABSTRACT

The objective of the study was to determine the effect of post consumption products and residues on human health and the environment, as defined by the Ministry of Environment and Sustainable Development of Colombia. We inquired about post-consumption residues known worldwide initially, contextualizing the inquiry at the national and regional level. The chemical, physical and / or biological composition of post-consumer waste was obtained from documental information collected on post-consumer waste described by MADS: pesticides, medicines, lead acid batteries, batteries and accumulators, tires, light bulbs and computers And / or peripherals. Except for exceptions (drugs), heavy metals are the substances with the greatest impact on human health and the environment; They are: Arsenic (As), Cadmium (Cd), Cobalt (Co), Chromium (Cr), Copper, Mercury (Hg), Nickel (Ni), Lead (Pb), Tin (Sn) and Zinc Zn). The affectations and diseases that waste and post-consumer products generate in the human being, and the detriment and pollution that these cause to the environment were communicated to the community through the realization of the "Seventh Integral Seminar on Environmental Engineering" held on 27 Of October of 2016 in the facilities of the UCEVA; Interactive workshops were also held with students of the Environmental Engineering program of the UCEVA; Is currently working in network with the Universidad Nacional in Production and Sustainable Consumption. Among the heavy metals, mercury, lead, cadmium, nickel and zinc are the most important in terms of health effects. Some intermediate elements such as arsenic and aluminum, which are very relevant from the toxicological point of view, are usually studied together with heavy metals.

Citation: Luis Carlos Villegas Méndez, María Eugenia Buitrago González, Sandra Santacoloma Londoño and Alexandra Naranjo Peñaranda. 2017. "Effect of post-consumer products and waste on human health and the environment, in Colombia", *International Journal of Current Research*, 9, (07), 54349-54359.

INTRODUCTION

In 2010 the Ministry of Environment and Sustainable Development of Colombia -MADS- generated the "National Policy of Production and Consumption.

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Towards a culture of sustainable consumption and productive transformation, "and although it is explicit in subjects such as the background of the current unsustainable production model, business competitiveness, employment generation, strategies and lines of action for sustainable production and consumption, The effect that post-consumer waste causes on human health and the environment is practically nothing mentioned. Since 2012, solid waste that needs special treatment, either because they are considered hazardous or

because they can be used as new inputs, are treated in Colombia in post-consumption programs. In 2014 the MADS advances a strategy aimed at promoting the environmentally sound management of post-consumer waste in order to be subject to differential management systems and prevent the final disposal is done jointly with household waste. The sectors currently regulated by the MADS, and considered post-consumer waste are: pesticides, medicines, lead acid batteries, batteries and / or accumulators, tires, light bulbs and computers and / or peripherals. In addition, MADS has developed voluntary strategies through alliances and agreements established with manufacturers and importers for the collection and environmentally appropriate management of disused mobile phones and refrigeration equipment. This strategy, as a fundamental element, involves the concept of extended producer responsibility, in which manufacturers and importers of products are responsible for establishing channels for the return of post-consumer waste, through which consumers can return such products when they are returned. Converted into waste (MADS, 2010). Other new waste is generated by an increasingly technologically advanced society: old appliances, all kinds of vending machines, modern instruments for surveillance and domestic and industrial control - such as smoke detectors, heating regulators, thermostats, measuring devices - toys, Ranging from the current portable consoles and video games to the oldest electric trains or cars on electric track. These apparently useless objects are known as WEEE, or Waste Electrical and Electronic Equipment (Quijada, 2013). There is a huge official void of information on the toxic and polluting effects on human health and the environment of some of the components of the sectors or products mentioned. As an example, there is the official invitation to use energy-saving light bulbs, not to mention that they contain up to 10 mg of mercury (Hg) per unit, and that when it breaks, the person who inhales this gas can see their health compromised of the central nervous system). Another example can be seen with the refrigeration unit of the refrigerators, constituted by chlorofluorocarbon gas (CFC), a great destroyer of the ozone layer, and that people, unintentionally and by ignorance of the subject, can alter or destroy this unit in a refrigerator in disuse with the consequences written down.

MATERIALS AND METHODS

To know the state of the art of waste and post-consumer products in Colombia, a documentary research was carried out on the post-consumption residues known at the global level, contextualizing the investigation at the national and regional levels. The research was carried out in university libraries and public sector companies (MADS, for example) and private companies linked to the post-consumer sector; Digitized information available on the network; Specialized magazines on products and post-consumer waste; Electronic databases. For the case of the institutional bases of The Unidad Central Valle del Cauca (UCEVA), we inquired about Virtualpro, Powersearch (Gale Virtual Reference Center Academic, Academic OneFile, Academic Report); The public databases investigated were Redalic, SciELO, Dialnet and Intech; Monographs and theses of degree and postgraduate, which provide results of recent research in the proposed topic, information that normally does not circulate in electronic networks. The chemical, physical and / or biological composition of postconsumer residues was obtained from pertinent information of the state of the art obtained from the previous point, evaluating scientific antecedents and research development in chemistry, physics and biology of the following products and postconsumer residues: Pesticides, medicines, lead acid batteries, batteries and / or accumulators, tires, light bulbs and computers and / or peripherals; Knowledge of the protocols for the elaboration of articles and products that will later be residual or post-consumer. The affectations and diseases that the residues and post-consumer products generated in the human being were socialized, and the detriment and pollution they cause to the environment through the realization of the "Seventh Integral Seminar on Environmental Engineering" held on October 27, 2016 in the facilities of the UCEVA; Interactive workshops were held with students of the Environmental Engineering program of the UCEVA; Is working in network with the Universidad Nacional in Production and Sustainable Consumption.

RESULTS AND DISCUSSION

The sectors currently regulated by the MADS, and considered post-consumer waste are: pesticides, medicines, lead acid batteries, batteries and / or accumulators, light bulbs and computers and / or peripherals. In addition, MADS has developed voluntary strategies through alliances and agreements established with manufacturers and importers for the collection and environmentally appropriate management of disused mobile phones and refrigeration equipment.

Pesticides

This term is defined by FAO (1986) as "any substance intended to prevent, destroy, attract, repel or combat any pest, including undesirable species of plants or animals, during the production, storage, transport, distribution and processing of food , Agricultural products or animal feed, or that can be administered to animals to combat ectoparasites. The term includes substances intended for use as plant growth regulators, defoliants, desiccants, agents for reducing fruit density or inhibitors of germination, and substances applied to crops before or after harvest to protect the product against deterioration during storage and transportation. The term does not normally include fertilizers, nutrients of plant or animal origin, food additives or drugs for animals. " With the advent of green revolution agriculture since the 1940s, the production and use of pesticides has reached troubling extremes. For the first time in history, the US government, through its agency of environmental protection EPA, pronounced clearly on the use of pesticides, admitting that one of the most used in the world, imidacloprid, neuroactive insecticide produced by Bayer , Designed from nicotine, is deadly for bees and other pollinators, with high residual power in the soil. In the European Union imidacloprid is prohibited (but not yet the glyphosate, equal or worse than poisonous). In 2010, 20,000 tons of imidacloprid were produced, making it the most used insecticide in the world (New Minds, 2016). Atrazine is the second herbicide commonly used in the United States after glyphosate, and the herbicide most commonly found in soil, rain and drinking water in the country. It is used in half of all maize grown in the United States. In 2005, the European Union (EU) banned atrazine, suspected of increasing health problems and environmental damage. Atrazine, even at levels as low as 0.1 part per billion (ppb), causes hermaphrodism in frogs. Atrazine activates the enzyme aromatase, which converts testosterone to estrogen. As Hayes (2016) pointed out, aromatase is very important in the development of breast cancer; the anti-cancer drug letrozole blocks aromatase, which

in turn blocks estrogen production. Ironically, letrozole is also produced by Syngenta, the same company that produces atrazine. High concentrations of water in drinking water have been associated with birth defects, including abdominal defects, gastroschisis (the baby's intestines protrude outside the baby's body). Atrazine is the most commonly detected pesticide in water supplies in the United States.

The use of pesticides, and the final disposal of packaging waste, is an aspect where there is not much information; Colombia is a country that abuses the application of pesticides in its agricultural and livestock production processes; It has over the years control and eradicate illicit crops with the herbicide glyphosate, and lacks a comprehensive and rigorous policy of disposal, not only of pesticide containers, but of pesticides that have expired or whose toxicity prohibits their use. It is also necessary to take urgent measures to avoid the use of pesticides at the domestic level (MADS, 2017). The highest risk herbicides in the world, taking into account their short, medium and long term toxicity: paraquat, diquat and glyphosate. The highest risk groups of insecticides are: organochlorines, organophosphates, carbamates, pyrethrins and pyrethroids. The most risky fungicides are: salts of copper (oxychloride and sulfate), carbamates (EBDC) (Vallejo and Baena, 2007).

Medications

Currently, Colombian regulations indicate that surplus drugs must be deposited in "blue spots", which are a load of transportation companies to take to specialized sites to incinerate them. Diego Quijano Prieto, a student of the Master's Degree in Environment and Development at the Universidad Nacional of Colombia (UN), surveyed 385 people in a first-level hospital of complexity in Bogotá and found that most patients do not know the blue dots ,,,,,,,,,,,,,,,,,,,,, ,,. The study showed that 64% of the people in the trash, 8% in the drainage and only 3.1% in a specialized site (Econoticias, 2017). Many active ingredients of the drugs reach the environment and stay there. In drinking water, several studies indicate that small amounts of drugs are recorded in animals, such as microorganisms and fish. Today we use the term "ecofarmacovigilancia" that refers to the need to monitor the adverse effects of drugs on the environment. For MADS Colombia (2017), expired drugs included in the controlled disposal plans are for human, veterinary, homeopathic and phytotherapeutic use. The term "expired medicine" includes the following residues: Containers, packaging, boxes, vials, vials, medicines whose expiration date has already expired, medications partially consumed. However, the following should not be given to the post-consumption plan: Syringes, needles, blades and other short sharp items, gauze residues, cottons, fabrics, cures, biological or infectious waste (tissue debris, body fluids), Are related to medicines (soap packs, shampoo bottles, domestic pesticide cans).

Throwing drugs or drugs that we no longer use or expired in the trash involves a high risk for the health of the environment and people, contaminating water sources and affecting the food chain (Semana, 2016). In the case of antibiotics, the greatest risk of not disposing of these residues well is to generate bacterial resistance, a phenomenon by which bacteria mutate and become resistant, so that antibiotics cease to have an effect against them. This is a big global problem. In-hospital infections are the best example of this. Antibiotic-resistant diseases pose a serious threat to public health, and evidence shows that the routine use of antibiotics in food animals such as cattle and chickens plays an important role in the development and establishment of human resistance to antibiotics (Mercola, 2016). Medications expire every five years on average. When they expire, the manufacturer does not ensure that their active ingredient has the same effectiveness, but that does not mean that they are harmless. As demonstrated by a study reported in 2014 by the CNN news network, eight prescription drugs expired between 28 and 40 years ago still had their active component. In a recent research from the Universidad Del Valle (Colombia), it was determined that through the wastewater the remains of pharmaceutical elements reach this watershed. The scientific investigations were carried out in five points of the Cauca River, passing through Cali, in which traces of 32 pharmaceutical elements were found. Ibuprofen and carbamazepine (anticonvulsant) are the drugs most frequently detected (Univalle, 2016). Article 32 of Decree 4741 of 2005 on the matter (MADS, 2014), states that "no person may dispose of drugs or expired drugs in landfills and in security cells or landfills, unless prior authorization is granted by the competent environmental authority and Adoption of environmental measures; Abandon drugs or drugs overdue in both urban and rural areas; Burning drugs or overdue drugs; Pour overdue drugs or drugs into bodies of water, public sewer systems, vacant lots or any other unauthorized site. " In practice, however, this is very little and citizens are unaware of the inferences and damages that such multiplicity of chemicals disposed of in the environment in an inadequate way cause the environment (soil, water, air) and subsequently to the human being.

Lead Acid Batteries

The lead acid battery is a device that allows to store electrical energy in chemical form and to release it when it is connected with an external consumption circuit. Chemical reactions may be reversible and therefore rechargeable. Its fundamental constituents are lead (Pb) as active substance and sulfuric acid (H2SO4) in dilution that allows electron transport (MADS, 2016). At this point the environmental and anthropogenic effect of lead and sulfuric acid will be addressed. Lead is commonly found in nature as lead sulfide in galena (PbS), or in other compounds, but very rarely as an isolated element. It is mainly intended for the production of ammunition, battery manufacturing, welding, piping, radiation shielding mainly against X-rays, in the manufacture of paints and as an additive (anti-knock) of gasoline. People can be exposed to lead at their workplace or in their environment, mainly through the inhalation of particles generated by the combustion of materials containing this metal (for example, during smelting, recycling in unsafe conditions or Handling paint with lead, or using leaded gasoline); The ingestion of contaminated dust, water or food (e.g., water channeled through lead pipes Or foods packaged in containers with lead enamel or welded with this metal). Another possible source of lead exposure is the use of certain cosmetic products and traditional medicines (WHO, 2016).

According to studies carried out by CONAMA / GTZ (2016), the most important risks and their effects on human health are: the ingestion of sulfuric acid can cause severe irritation in the mouth, throat, esophagus and stomach; Lead ingestion can cause severe abdominal pain, nausea, vomiting, diarrhea and cramping; Acute ingestion can rapidly lead to systemic

toxicity. In contact with the skin sulfuric acid causes burns, ulcers and severe irritation. Lead compounds are not absorbed through the skin. In contact with the eyes, sulfuric acid causes severe irritation, burns, damage to the cornea and blindness. Lead compounds can cause irritation. An acute (for once) overexposure of sulfuric acid causes severe skin irritation, damage to the cornea that can cause blindness, and upper respiratory tract irritation. Lead compounds produce symptoms of toxicity including headache, fatigue, abdominal pain, loss of appetite, muscle pain and weakness, changes in sleep patterns and irritability. Chronic (long-term) overexposure of sulfuric acid causes erosion of tooth enamel, inflammation of the nose, throat, and bronchial tubes. Lead compounds cause anemia, neuropathy, particularly motor nerves, wrist drop, kidney damage, and reproductive changes in both men and women. Chronic disease caused by lead poisoning is called lead poisoning.

Anemia is the classic manifestation of lead toxicity. Exposure to lead reduces the lifespan of erythrocytes and inhibition of heme biosynthesis. Both adults and children develop neurotoxicity, with children being more susceptible. Decreased IQ, slow performance, excessive sleep, and pain and tenderness in the muscle have been observed to increase with increasing levels of lead in the blood. Paralysis of the extensor muscle with "wrist drop" or "ankle fall" has been recognized as the classic clinical manifestation of neurotoxicity. Chronic nephropathy, which may progress to renal failure, is common in workers with blood lead levels above 60 [mu] g / dL (Ahmad, 2014). In occupational exposure, toxicology of lead is known: its vapors and fumes reaching the lung are absorbed by 50%. The blood distributes this metal to the whole organism, where it can injure soft organs, such as the central and peripheral nervous system. But the earlier and ostensible damage causes it in the blood, increasing its concentration in the red blood cell. The end result of this damage is normocytic and hypochromic anemia, with secondary increase of serum iron. Finally, lead is excreted in 75% by the kidneys, which can also injure. Lead is a very dangerous neurotoxic for the embryonic development of the brain and hence the risk of pregnancy in women of fertile age exposed (Ramirez, 2008). Lead affects the brain development of children. There is no safe blood concentration (WHO, 2016).

High levels of lead were found in most brands of solvent-based paints in Colombia. The Sustainable Development Network, together with IPEN - A future without toxics for all - and Colnodo, presented in October 2016, the results of the study: "Lead in solvent-based paints for domestic use in Colombia", performed as part of an initiative that seeks to eliminate lead in paints globally. Sixty-four percent of the paintings analyzed in this study contained high levels of lead, 25 of the 39 samples analyzed contain a total lead concentration of more than 600 parts per million ppm, the regulatory limit of lead content in decorative paints in countries such as South Africa, Brazil and Sri Lanka, among others. Furthermore, 59% of paints contain high and dangerous lead concentrations in excess of 10,000 ppm. The highest total lead concentration detected was 250,000 ppm manufactured by the company "Pinturas Tito Pabón" in orange color in ¼ gallon presentation marketed for domestic use. The health impacts of lead exposure on the brains of young children are lifelong, irreversible and incurable, says Placido Silva, an engineer who coordinated the study in Colombia by Colnodo and the Sustainable Development Network. Most highly industrialized countries adopted laws or regulations to control the lead content of paints - decorative paints used in the interiors and exteriors of homes, schools and other children's centers - since the early 1970s and 1980s The most stringent standard, 90 parts per million (ppm) of the total lead content in decorative paint, is common in many countries, including the Philippines, Nepal, and the United States of America. Several other countries, including Singapore and Sri Lanka, have a standard with a total lead level of 600 ppm. Lead is one of four metals that have a greater harmful effect on human health. This can enter the human body through food (65%), water (20%) and air (15%) (Lenntech, 2017). Meals such as fruit, vegetables, meats, grains, seafood, soft drinks, and wine may contain significant amounts of lead. Cigar smoke also contains small amounts of lead. Lead can enter drinking water through corrosion of pipes. This is more common when the water is slightly acidic. Lead accumulates in the bodies of aquatic organisms and soil organisms. The health effects of crustaceans can occur even when there are only small concentrations of lead present. Pb interferes with the functions of phytoplankton, which is an important source of oxygen production in seas and many large marine animals eat it.

Lead contamination can influence global balances; Soil functions are disturbed by lead intervention, especially near highways and crop lands, where extreme concentrations may be present. Soil organisms are also poisoned by this heavy metal (Lenntech, 2017). According to Hurtado *et al*. (2008), "lead is an innocuous metal as long as it is not handled in industrial processes. Even though leaded gasoline has been eliminated in many countries, even in Colombia, informal battery recycling remains a potential source of exposure and poisoning for both workers and their families in the lower strata. “It is common in the Colombian environment that artisanal fishermen manipulate the batteries to obtain the lead that they use in their fishing implements without keeping the minimum security protocol. Tetraethyl lead, used as an antiknock in gasoline, is a volatile liquid that causes severe alterations in the central nervous system (mental retardation, cerebral palsy) (Vallejo and Baena, 2007).

Batteries and / or accumulators

The batteries and accumulators referred to in the MADS strategy are: alkaline batteries and Zinc Carbon (commonly used in domestic appliances); Batteries for calculators, watches, headphones, among others, and rechargeable batteries for cameras, computers and other portable devices, which are currently not handled safely and properly. The most commonly used types of batteries in our environment are (Zabaleta, 2005): 1. Normal batteries, type Leclanché, or zinc / carbon (Zn / C), or "dry batteries": have a mercury content of less than 0.025 % of their total weight. It is the most common battery, widely used in low consumption devices such as portable radios, flashlights, toys and mechanical devices. Provides an electromotive force of 1.5 v. 2. Alkaline or zinc / manganese dioxide (Zn / MnO2) batteries: have a mercury content in the range of 0.1% of their total weight. It is an improved version of the Leclanché cell, in which the ammonium chloride ion conductor is replaced by potassium hydroxide (hence its alkaline name). 3. Nickel / cadmium (Ni / Cd) batteries: it is better known as a rechargeable battery. The negative pole is a cadmium sheet and the positive pole is a sheet of nickel hydroxide. 3. Button cells: also called mercury cells, with a content of this element of about 30% of its weight. The

electromotive force produced is 1.35 v. The negative pole is zinc amalgam and the positive pole is steel in contact with a paste of mercury oxide, potassium hydroxide and zinc hydroxide. 4. Mercuric oxide batteries: they are the most toxic, they contain approximately 30% of mercury. They should be handled with caution in homes, since their accidental ingestion, which is feasible because of its shape and size, can be lethal. 5. Zinc-air piles: they are distinguished by having large number of tiny holes in their surface.

They are very capable and once in operation their electricity production is continuous. They contain more than 1% mercury, so they have serious residual problems. 6. Nickel / metal hydride (Ni / MH) batteries are secondary batteries such as nickel / cadmium, but cadmium is replaced by a metal alloy capable of storing hydrogen, which plays the role of anode. The cathode is nickel oxide and the electrolyte is potassium hydroxide. 7. Silver oxide piles: They are small in size, usually of the button type, with a mercury content of about 1% of their weight, approximately, so they have toxic effects on the environment. 8. Lithium batteries: produce three times more energy than alkaline batteries, do not carry mercury in their composition, have a slightly larger size than mercury oxide and also have a higher initial voltage (3 volts). They are used in watches, calculators, flashes of cameras and computer memories. Studies carried out by MADS (2010) tell us that in the last seven years, about 77,000 tons of waste batteries have been generated and disposed of in the landfills and open pit in Colombia, along with domestic waste. This means about 14,000 tons of zinc, 13,000 tons of manganese, 60 tons of cadmium, 15 tons of chromium, 100 tons of nickel, 30 tons of lead, 350 kg of mercury and 350 kg of lithium.

Tires

Used tires are not considered as hazardous waste in Colombia, however, they must be returned to the producers in order to promote recycling, use as an asphalt aggregate or recharge, as well as to prevent them being burned in open spaces and as fuel in activities Informal. The use of tires used as fuel is regulated by Resolution 1488 of 2003 (MADS, 2010). The types of rubber most used in the manufacture of tires are: natural rubbers (NR), polybutadienes (BR), styrene-butadiene (SBR) and synthetic polyspermos (IR). Further materials are added to the rubber to improve its properties, such as: softeners, which increase the workability of the rubber, prior to vulcanization; Zinc oxide and magnesium. The most commonly used rubber matrix is styrene-butadiene copolymer (SBR), wherein the ratio is about 25% by weight of styrene, or a mixture of natural rubber and SBR (Castro, 2008). All types of rubbers have different properties, but also with something in common: all, once vulcanized, can be very durable, so they would need a lot of time for degradation. According to Holderbank (1997) the different chemical elements that make up a tire, and usually vary according to the type of tires and the country of manufacture, are: carbon (C), hydrogen (H), sulfur (S), chlorine Iron (Fe), zinc oxide (ZnO), silicon dioxide (SiO), chromium (Cr), nickel (Ni), lead (Pb), cadmium (Cd) and thallium (Tl). The tires are composed of rubber (80%), steel (15%) and fibers (5%), and from them can be extracted by-products for various sectors of industry. In 2015, more than 5.3 million tires were sold in Colombia, which, once they have reached their life cycle, can end up in streets, avenues and parks, creating an environmental and public health problem for citizens (Suarez, 2016). The country has the capacity to process 10 million tires a year, but only reaches 20 percent because the by-products obtained are not meeting their marketing quota. One of the outputs that could be processed tires is on the modified asphalt, which is combined with very small grains of recycled rubber to offer higher quality conditions in road construction. With rubber, in addition to the modified asphalt, granulate can be used for synthetic fields, footwear, pavers, as a substitute for sawdust and to replace traditional fossil fuels, because, according to experts consulted, it can generate more energy than coal. With the application of physicochemical technologies, other by-products, such as oils and diesel fuels, can also be obtained after refining. And there is an application that can even be achieved without processing the tire: as a raw material for engineering works to control erosion, in distant places where bringing the tire to a collection plant can be complex.

The Greek expert Antonis Mavropoulos, founder of the D-Waste company and president of the International Association for Solid Waste - ISWA - in his recent visit to Colombia said waste such as tires, batteries, computers, etc., needs a different process to Their post-consumption because they contain dangerous substances that can cause great problems to the environment and health if disposed of in landfills or disposal sites without controls (Suarez, 2016). For example, in Indonesia and the Philippines, the health impact of this type of hazardous industrial landfill is greater than that produced by malaria. The best way to do this is to apply the Extended Producer Responsibility (REP) principle, which states that the producers of these elements are also responsible for organizing their administration once they reach the end of their useful lives. If not disposed of properly, waste tires can cause environmental problems and human health. These include their contribution to sewer and flood obstruction, river contamination as well as high volume landfills. Waste tires are one of the main sources of proliferation of the mosquito Aedes aegypti, vector of dengue disease (Víquez, 2014); But it is also a vector of yellow fever, zika and chicunguña. In addition, when this waste is burned outdoors or in ovens where the temperature and retention time are not controlled, it generates a large amount of air pollution due to dioxin and furan emissions, mainly (Mayer, 2013). In Colombia, a large part of the tires after use are stored in clandestine warehouses, roofs or courtyards of housing houses and public spaces (lakes, rivers, streets and parks) with serious consequences in environmental, economic and health terms. Used tires become the ideal habitat for vectors such as rats and mosquitoes, which transmit diseases such as those mentioned above. When used tires are laid out in open dumps, they contaminate the soil, renewable natural resources and affect the landscape. In addition, they generate difficulties in the operation of landfills (Ministry of Environment, 2010). Some subsectors use tires used as fuel in their production processes inadequately. Likewise, informal groups that are part of the chain of used tires, burn them to open sky to extract the steel, generating problems of air pollution.

These contaminants cause cancer, congenital malformations, adverse effects on the hormonal, immune and central nervous systems, generate problems in the lungs, among other disorders in health. The burning of tires represents the combustion of organic materials which, in addition to heat, produces the physical and chemical disintegration of rubber, leaving in the air compounds that are harmful to living things and the environment. This process produces the so-called black smoke

which, as has been shown, can contain, in addition to monoxide and carbon dioxide, sulfur dioxide, which in the atmosphere can be converted to acid rain. Also heavy metals listed as permanent organic pollutants and chlorocarbons, which are responsible for the deterioration of the ozone layer. The concentration and amounts of these elements in the air depend on the quantity, type of rubber burned, the duration of the combustion and the environmental conditions (which allow the dispersion or not of the smoke rapidly). The health effects can range from irritation of the airways and exposed mucous membranes (conjunctiva, mouth and throat), with reactions ranging from coughing, tearing, increased secretions and difficulty breathing. People who are susceptible or have concomitant lung diseases (asthma, Epoc and pneumonia) can develop complications when they come into contact with smoke, as do children and older adults. When contact with the smoke is permanent, alterations may occur in the skin and other organs, including digestive organs (Fernandez, 2014). In November 2014, 600,000 used tires were set on fire in the town of Fontibón (Bogotá). According to the analysis done by the University of the Andes Public Health Studies Group, concentrations of pollutant particles (soot and smoke) with hydrocarbon compounds - some of high toxicity and carcinogens - exceeded the limits allowed for health Up to 400 percent.

The coordinator of this study group, Luis Jorge Hernández, reported that, according to the measurements of the stations of the departmental secretariat ofenvironment (SDA), concentrations of particulate material (PM10) reached 250 micrograms per cubic meter. The contamination exceeded five times the maximum allowed, which is 50 micrograms per cubic meter, as set by the World Health Organization (WHO) (El Tiempo, 2014). Air emissions from the burning of open-pit tires have been shown to be highly toxic, even mutagenic, as they include pollutants such as particulates, carbon monoxide (CO), sulfur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), dioxins, furans, hydrogen chloride, benzene, polychlorinated biphenyls (PCBs) And metals such as arsenic, cadmium, nickel, zinc, mercury, chromium, and vanadium. In addition, significant amounts of liquids and solids can be generated with harmful chemical contents derived from the casting of tires, which may be potential pollutants of soil, surface water and groundwater (Alcaldía de Bogotá, 2014).

Bulbs

All sources of artificial light involve the conversion of some form of energy into electromagnetic radiation. This is a physical process that occurs at the atomic level; The excitation and subsequent de-excitation of atoms or molecules is the most used process for the generation of light in artificial sources (O'Donnell, Sandoval, & Paukste, 2006, cited by Miranda *et al*., 2015). There are three large groups of bulbs or lamps used in the population; the first is the incandescent lamp or traditional light bulb, which produces light by heating a metallic filament (tungsten) activated by the electric current that is transformed into heat. These light bulbs are inefficient since 90% of the electricity consumed transforms it into heat and the remaining 10% into light. A better luminous performance is achieved with the halogen incandescent lamp, which works with the same principle of the traditional bulb.

The second group consists of a fluorescent lamp, consisting of a sealed glass tube, with argon gas inside it at a low pressure (2.5 torr, 0.00329 atm), as well as a low mercury vapor pressure, Tube is covered with a powder of several aggregates composed of phosphorus, which determines the color of light produced. The composition of this powder shows that it contains aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel and zinc (Angulo and Romero, 2006). These investigators point out that mercury (Hg) remains in tube fluorescent lamps after use and that it could vary depending on the company that manufactures them and the handling given during and after use. Mercury has characteristics of toxicity independent of its concentration, has characteristics of bioaccumulation and all the mercury that is released to the environment will eventually end up in the soil, surface water, in the air and inevitably in man. It is toxic by inhalation and very toxic to aquatic organisms.

The third group is occupied by the most commonly used light bulbs and lamps on the market today, LED (Light-Emitting Diode) being the most harmful for the night environment and harmful to human health. White light LEDs are based on the blue LED with a color correction through a phosphor layer, analogous to fluorescent tubes. They affect the environment by the emission of intense light at wavelengths near 440 nm (several regulations contemplate limiting these radiations to protect biodiversity). White light is the most disturbing behavior of nightlife species and, therefore, the one that most affects the conservation of biodiversity in its natural conditions. This type of light causes faster inhibition of the secretion of the hormone melatonin by the pineal gland in humans. This is because the circadian receptors that we possess in the retina are more sensitive to that peak of light emission in the blue wavelengths. This hormone is only secreted in dark conditions and, in addition to controlling the circadian rhythms, it is a broad spectrum antioxidant that protects our body, among other diseases, against degenerative alterations and against certain types of cancer, preventing its progression. There are very active lines of research that relate exposure to artificial light at night with a higher rate of breast cancer in women and of prostate and colon in men. The decrease in melatonin production in humans and animals caused by ambient and wavelength illumination, especially short (between 470 and 525 nm), has been shown to be associated with an increased risk of cancer (Kayumov *et al*., 2007). Another aspect considered environmentally negative is the high glare capacity of LED-based lamps due to their high luminance (light emitted per unit area), in some cases up to a thousand times greater than traditional luminaires. The population most potentially affected by these risks is children (because they have not yet fully developed lens screening ability) and people with age-related macular degeneration, as well as professionals (lighting technicians, surgeons) or Patients exposed for long periods or repeatedly to this type of light.

Artificial light, especially the shorter wavelength (more blue and energetic) dampens the natural cleaning of polluted air at night, in the same way as sunlight does during the day. By destroying part of the nitrate radical by artificial light, the production of ozone and other nitrogen oxides also increases at night. Epidemiologists warn that the use of this cold white light in lighting contributes to the spread of insect-borne diseases (Chagas' disease, leishmaniasis and malaria) (Dorremochea *et al*., 2011). But of all the components present

in light bulbs is mercury that offers greater danger to human health and the environment. The sources of mercury emission are very varied, but the National Institute of Ecology and Climate Change of Mexico (INECC, 2000) identifies the following: Secondary lead smelters, gold mining and refining, dentistry (amalgams), crude oil refineries, Portland cement, cement plants, fluorescent lamps, thermometers, thermoelectric plants, iron smelters, cremation, mercury batteries, bio-infectious hazardous waste incinerators, hospital waste, sphygmomanometers, hazardous industrial waste incinerators, natural gas, plants Coal combustion, wood combustion and glass production. Colombia occupies the third place in contamination of its environment by mercury, because the country releases 205 tons of mercury of the 590 that imports. A number of global reports, such as the United Nations Industrial Development Organization, show alarming rates of aquatic, terrestrial and atmospheric pollution, with the departments of Chocó, Bolívar and Antioquia having the highest mercury pollution in the country (Cuevas, 2015). Mercury affects the function of neurons and various biochemical systems, producing neurological problems including insomnia, loss of appetite and memory, movement disorders, decreased sexual activity and depressive states; these alterations can be confused with clinical pictures of other diseases, making difficult the clinical diagnosis of the chronic intoxication by the metal. Jesús Olivero-Verbel, coordinator of the Doctorate in Environmental Toxicology and Vice-Rector of Research at the University of Cartagena, Colombia, quoted by Cuevas (2015), after analyzing the hair samples of 1,548 people from all over Bolívar department, found that Average mercury concentration was 1.7 parts per million (ppm), where the standard recommends not to exceed 1 ppm.

In the Amazon department, in the Caquetá river basin, in the Araracuara Indians, in the Miraña and Bora communities, 15 times more methylmercury has been found in the body than the World Health Organization considers acceptable. Mercury is used to separate gold from the ore by forming an "amalgam", which is a mixture of approximately equal parts of mercury and gold. The amalgam is heated, whereupon the mercury evaporates and gold remains. This technique generates approximately 37% of the mercury emissions and is the major source of air and water contamination with this metal (Yard *et al*., 2012). Mercury vapors affect not only mining practitioners but also communities close to the extraction centers. The mercury vapors finally fall to the ground and the sediment that reaches lakes, rivers, bays and oceans is transformed into methylmercury by the action of anaerobic microorganisms. In water bodies, methylmercury is absorbed by phytoplankton, ingested by zooplankton and finally by fish, thereby contaminating the food chain .Elemental mercury and methylmercury produce toxic effects on the central and peripheral nervous system.

Inhalation of mercury vapors may produce harmful effects on the nervous system, digestive system, immune system, lungs and kidneys, and may cause death. Neural symptoms include mental retardation, seizures, visual and auditory deficits, developmental delay, language disorders and loss of memory. Chronic exposure to mercury in children has been reported to cause a syndrome characterized by painful redness of the extremities (acrodynia) (Yard *et al*., 2012). Mejía *et al*. (2016) confirm that methylmercury has the capacity to accumulate in organisms (bioaccumulation) and to concentrate on food chains (biomagnification), especially in the aquatic food chain (fish and marine mammals). In the human body, the nervous system is very susceptible to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, as more of these come to the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the kidneys, brain, and fetus. Effects on brain function may manifest as irritability, shyness, tremors, visual or auditory impairment, and memory problems (Romero and Angulo, 2006). It is especially difficult to distinguish between a natural mercury source (mercury enters the environment from volcanic activity or rock erosion) and the remobilization and reissue of mercury that originally entered the environment from an anthropogenic source and Was subsequently deposited in water or on land.

Today one of the largest known ecosystems, the oceans, are contaminated by mercury. For Lamborg *et al*. (2014), it has been estimated that the total amount of anthropogenic mercury present in the world's oceans can be 80 ± 290 million moles, of which almost two-thirds are in waters less than one thousand meters deep. These findings suggest that anthropogenic disturbances of the global mercury cycle have led to an approximate 150% increase in the amount of mercury in thermocline waters, and the mercury content of the surface waters of the seas has tripled in Comparison with pre-anthropogenic conditions. An example of organic mercury contamination occurred in the city of Minamata, Japan, between 1932 and 1968. It was the first well-documented case; Happened when about 27 tons of mercury compounds and other contaminants were dumped in Minamata Bay. Organic by-products of mercury, which were the result of the production of acetaldehyde, were discharged into the bay when Chisso Corporation began to develop plastics and perfumes (Yacuzzi, 2008). Methylmercury has adverse effects on many living organisms. Some studies indicate that small increases in methylmercury exposure may adversely affect the cardiovascular system (Montenegro & Nicolalde, 2012). In another study, acute tubular necrosis (NTA, renal cells damaged by a toxicant or a damaging substance) was shown to exceed permissible parameters through experiments with rats exposed to an inorganic mercury compound (mercury chloride) (Hernández -Pando *et al*., 1995). Today almost all marine fish and seafood contain some trace of mercury. Mercury can especially harm the developing fetus or nervous system of a young child (EPA & FDA, 2004).

In 1971, to the Iraqi port of Basra, a cargo of 90,000 metric tons of US barley and Mexican wheat arrived to be used as seeds. The cereals had been treated with methylmercury as an antimycotic to prevent them from rotting. They were supposed to be intended for farmers and had warnings printed in English and Spanish on the bags. However these languages were not commonly used in the port city and a large amount of grain was sold locally as food. It is estimated that as a result of mercury poisoning 10,000 people died and another 100,000 were left with severe and permanent brain damage (Bell *et al*., 2014). It is generally accepted that systems for developing organs (such as the fetal nervous system) are the most sensitive to the toxic effects of mercury.

Computers and / or peripherals

According to studies carried out in the European Union, on average, electrical and electronic equipment is composed of 25 percent reusable elements and 72 percent recyclable materials

(plastics, ferrous metals, aluminum, copper, gold, nickel or tin) (Silva, 2014). 49 million metric tons of electronic waste were produced in 2013 in the world. 3% of these wastes contain potentially toxic elements, including lead, mercury, beryllium, selenium, cadmium, chromium, halogenated substances, or other more complex ones such as chlorofluorocarbons, biphenyls, arsenic and asbestos, among others. For example, a computer screen has lead, and when it is improperly destroyed or disposed of in an improper location, there is a potential for degradation of that substance to contaminate groundwater. Something similar happens when that same screen is thrown in an open garbage dump, like a can, a plastic container or other traditional waste, which are often incinerated. All are very aggressive substances for the soil and air, and seriously affect health. Arsenic, present in semiconductors, causes brain and cardiovascular injuries. How to take good advantage of what is potentially recyclable and properly dispose of what contaminates? That is the challenge facing the world with an increasingly consumerist society.

Electronic scrap from computers, telephones, cell phones, fax machines, printers and various appliances, when it is dismantled, separated from its original structure or disassembled, a part of its components (printed circuits, capacitors, batteries, cathode ray tubes, toners, Catalysts, among others) become waste with potentially hazardous substances for health and the environment. This is because it has the following components: lead, mercury, cadmium, beryllium, arsenic and brominated compounds (Protomastro, 2007). In 2016, nearly 49 million metric tons of electronic waste were produced worldwide, equivalent to 7 kilograms per inhabitant of the planet, a figure that will increase by 33 percent in 2017, according to a study by the United Nations University (2016). 80% of this waste goes to sanitary landfills and the other 20% to garbage dumps. The same source indicates that associations have been found between exposure to inadequate treatment of electronic waste and impaired thyroid function, reduced lung function, negative outcomes at delivery, decreased child growth, negative mental health outcomes , Impairment of cognitive development, cytotoxicity and genotoxicity (Ecoticias, 2017). Recyclers in several countries recover gold, silver, palladium and copper, mostly from printed circuit boards (PCBs) and wires using dangerous wet chemical leaching processes commonly known as acid baths. Normally, informal recyclers use solvents, such as sulfuric acid (for copper) or royal water (for gold). Leachate solutions undergo separation and purification processes to concentrate valuable metals and separate impurities, which often results in the release of toxic vapors. In the absence of protective materials such as gloves, goggles and masks, inhalation and exposure to chemicals and hazardous substances directly affect the health of workers. There is the practice of open burning by informal recyclers when separating organic and inorganic compounds (eg, burning cables to recover copper).

In Colombia in 2014, about 150,000 tons of computer and peripheral waste were generated; the selective collection program carried out by ANDI through Ecocómputo collected 1,070 tons of electronic waste in 2013 (El País, 2014, page E3). Galvis (2012) reports that on average, more than 70% of the weight of obsolete computers and telecommunications equipment is in metals, plastics and their respective mixture, as follows: metals 43.6%, plastics 27.7%, glass 19.5%, metal-plastic mixture 5.3%, cards 2.0%, cables 1.3%, cables 1.3%, hazardous substances 0.5%. Among the toxic compounds are: cadmium, whose compounds are carcinogenic to humans; Lead, which can accumulate in the body through repeated exposure and have irreversible effects on the nervous system; Phthalates interfere with normal development in infants; Antimony, carcinogenic in humans; Polychlorinated biphenyls, are associated with a wide range of toxic effects including suppression of the immune system, liver conditions, among others; Chlorobenzene, a chemical that acts as an endocrine disruptor through repeated exposure and has irreversible effects on the nervous system.

Cell Phones

According to the US Environmental Protection Agency, for every million mobile phones recycled in 2016, weighing about 70 tons, 16 tons of copper, 350 kilos of silver, 34 kilos of gold and 15 kilos of palladium can be recovered (FER, 2016). Among the basic physical components of a cellular equipment in its external part are a case made of plastic material, usually ABS or some alloy thereof; A monochrome or color display with a glass, plastic or glass cover; A numeric keypad and an antenna; Its internal components are based on a printed circuit board with integrated chips, resistors, conductances, capacitors and wires; You will also find a microphone, speaker and battery. These components may contain a wide variety of organic and inorganic chemicals, most notably ABS-PC (acrylonitrile butadiene styrene / polycarbonate),Which consists of a mixture of polycarbonate and styrene, and whose percentage in the equipment equals 20; In lower concentrations contains copper 19%, iron 8%, glass 11%. It also contains aluminum, PMMA (polymethyl methacrylate), silicon dioxide (SiO2), POM (polyoxymethylene), PS (polystyrene), TBBA (tetrabromobiphenol A), nickel, LCP (liquid polymer crystal and PET (Zabaleta However, it is the batteries that worry the most when they are disposed of in "dumps" or sanitary landfills, as they generate a problem due to the leaching of the components, especially in the conditions of humidity, pH and temperature of such landfills. Leachates are composed essentially of heavy metals, and can reach groundwater, altering their quality and becoming a source of contamination for humans, animals and crops that come into contact with that waste. Another problem is batteries, because a micropile of Mercury can contaminate 600,000 liters of water by releasing its components of mercury or cadmium, which upon contact with the earth and subsequently filtering and reaching the Groundwater contaminates the food chain (Zabaleta, 2005).
In other parts of the world, such as Sweden, since 1986 batteries have been collected. Hazardous waste is considered hazardous waste in Switzerland and it is prohibited to bury or dispose of it in landfills. In that country, mercury, zinc and manganese are recovered for recycling, as well as encouraging the use of equipment with rechargeable batteries, appliances with a discount of 10% and a label with the ISO symbol that alerts the consumer about the danger of Batteries and remembers that once exhausted they must be returned to the point of sale. In Austria since 1991 it is prohibited to dispose of it with the common garbage; In Spain since 1993 no batteries with high mercury content have been manufactured and in Germany since 1993 they have forced the manufacturer and the merchant to recycle them.

Used cell phones are considered by international regulations to contain hazardous waste due to the effect they have on the environment and health. The three main constituents that affect

the difficulty of the final disposal of the cell phone are: 1. Batteries, which contain heavy metals such as nickel, cadmium, hydride and lithium, among others. 2. Electronic cards, containing iron, copper, zinc, silver and others. 3. The cover, made of ABS-PC, which is a hard plastic whose synthesis requires butadiene, styrene and acrylonitrile; is very toxic and difficult to recycle due to its complex chemical composition (Zabaleta, 2005).

Disused refrigeration equipment

Electrical appliances that generate more pollution, if not selectively collected and properly treated in facilities authorized for decontamination, are, according to Quijada (2013), cold equipment (refrigerators, freezers, air conditioners), televisions and monitors Of computers and lamps (fluorescent, compact and low consumption). In Colombia, the post-consumer program Red Verde, guarantees the environmentally safe disposal of refrigerators that have completed their life cycle, which is approximately 14 years. The non-usable elements such as refrigerant gases, oils and polyurethane foams are extracted safely by Red Verde, and managed through processes that guarantee their adequate destruction (Semana, 2017). Ozone acts as a filter for the harmful, high-energy radiation that reaches the Earth allowing others to pass, such as the long-wave ultraviolet, which thus reaches the surface. Decreasing the ozone layer can lead to increased cases of skin cancer, cataracts in the eyes, suppression of the immune system in humans and other species. In order to preserve the ozone layer, the use of chemical compounds such as chlorofluorocarbons, CFCs (industrial refrigerants), and soil fungicides, such as methyl bromide, which destroy the ozone layer at a rate 50 times greater than The CFCs (Plazas, 2012). CFCs can remain between 50 and 100 years in the atmosphere. When they reach the stratosphere they are dissociated by the action of ultraviolet radiation, releasing the chlorine they contain, responsible for initiating the process of destruction of the ozone layer. Until recently, CFC-11 and CFC-12 were commonly used in low pressure liquid chillers, domestic and commercial refrigeration systems, as well as in air conditioning. The refrigerant is removed in its present condition and stored in a disposable or transferable cylinder. This unit removes the oil from the coolant, and can handle steam or liquid in a very fast time. The refrigerant can then be recycled at the service center or sent to a reprocessing station for later reuse. The refrigeration gases from the cold equipment have to leave the recycling chain, passing through a cryogenization line, where they are liquefied with liquid nitrogen, and then, once converted into liquid, they are packaged and shipped to a specialized plant of toxic waste to eliminate them. These highly polluting residues account for 2% of the total volume of stored material (Quijada, 2013).

Conclusions

4.1. It is the producer or importer of a product, which, in the interest of selling it, does not show - or minimize - the toxic or polluting effects of the same, and does not disclose or deliver to the consumer accurate and widely disseminated information about the need To adequately dispose of the waste or post-consumer products, and the danger that its mismanagement entails. Must the MADS for the Colombian case enforce the concept of extended producer responsibility, in which manufacturers and importers of products are responsible for establishing channels for the return of post-consumer waste, through which consumers can return such products when these They become waste. Of the 106 chemical elements currently known to man, and which largely the support of known life are, 84 are metals, and therefore the pollution of the environment by man's misuse of them is very high. Among the heavy metals, mercury, lead, cadmium, nickel and zinc are the most important in terms of health effects. Some intermediate elements such as arsenic and aluminum, which are very relevant from a toxicological point of view, are usually studied together with heavy metals. An aggravating factor: very few medical centers in Colombia investigate heavy metal poisoning.

The most important heavy metals from the environmental point of view are Arsenic (As), Cadmium (Cd), Cobalt (Co), Chromium (Cr), Copper (Cu), Mercury (Hg), Nickel Pb), Tin (Sn) and Zinc (Zn).

Lead is one of the four metals that have the greatest harmful effect on human health. This can enter the human body through food (65%), water (20%) and air (15%) (Lenntech, 2017). Lead acid batteries, commonly used in vehicles (cars and motorcycles), contain lead and sulfuric acid, which we generally handle and dispose of without any real knowledge of its toxic effects on the environment and human health. Anemia is the classic manifestation of lead toxicity. Exposure to lead reduces the lifespan of erythrocytes and inhibition of heme biosynthesis. Both adults and children develop neurotoxicity, with children being more susceptible.

Colombia occupies the third place in pollution of its environment by mercury, mainly by its misuse in the mining. Domestically, batteries are a major contaminant with this metal. A mercury micropile can contaminate 600,000 liters of water by releasing its mercury or cadmium components; when they come into contact with the soil and subsequently filter and reach groundwater contaminate the food chain (Zabaleta, 2005).

In Switzerland batteries are considered hazardous waste and it is prohibited to bury or dispose of them in landfills. In that country, mercury, zinc and manganese are recovered for recycling, as well as encouraging the use of equipment with rechargeable batteries, appliances with a discount of 10% and a label with the ISO symbol that alerts the consumer about the danger of Batteries and remembers that once exhausted they must be returned to the point of sale. In Germany since 1993 the manufacturer and the trader are obliged to recycle them.

Arsenic, present in semiconductors of electrical and electronic equipment, causes brain and cardiovascular injuries. Cadmium is associated with bladder and prostate cancer.

The challenge facing society today, from the point of view of consumerism, is to differentiate how to take good advantage of what is potentially recyclable and to properly dispose of what contaminates.

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