ПРОБЛЕМНАЯ СТАТЬЯ

ENVIRONMENTAL IMPACTS OF HUMANITY'S CARELESSNESS
PART II: INDUSTRIAL WASTES AND AQUATIC HAZARDS

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ABSTRACT. It is a well-known fact that human beings are in the process of rapidly modernizing the world by utilizing various natural resources at an unprecedented speed. The accomplishment can initially be mistaken as human's great achievement, but during the course of this swift development, we have been adding extra pressure on the environment, especially by disposing the harmful chemicals of industry. Secondly, we humans are also overly using the limited sources of nature, which is resulting in its depletion, eventually interrupting the natural cycle. Metals are the indispensable raw material for constructing infrastructures and for producing electronic products. However, extracting these metals from their corresponding ores can inflict serious consequences if no precautions are taken. Similarly, the ever-changing fashion industry has exponentially raised the demand for cotton, which has eventually encouraged people to exploit the natural resources like water even more, resulting in climate change and even drying up of the whole sea in some cases. These activities also impose a formidable threat to the environment we live in and even can lead to the end of human existence. Due to human's carelessness, the concentration of harmful chemicals in water, soil, and the air is already far higher than the permissible upper limit in many regions. These unacceptable higher levels of these harmful chemicals directly affect the health of not only human beings but all the living organisms living on the Earth. If the process is not curbed on time, we humans, with other wildlife and innocent organisms are bound to pay a hefty price.

KEYWORDS: pollution, cotton, dye, thallium, aluminium, arsenic, mercury, tin, lead.

INTRODUCTION

At the first look, it seems as if human industrialization has made a great stride in past centuries, as we're able to extract metals required to power up our modern world. But another facet of modernization greatly goes snubbed. The same process, on the other hand, is also responsible for polluting the environment, since a lot of toxic metals are released back into the environment during the procedure.

The second problem is the vogue of the 21st century, related to the fashion industry. The ever-lasting fashion change has increased the demand for corresponding resources like clothes, which adds a toll on the environment by increasing the use of freshwater in cotton. The dye is another culprit because its by-products are released directly into the river without proper treatment. The toxic elements, released with it have dreaded effects on the environment.

CONTEMPORARY INDUSTRIALIZATION

Now let's see how the fashion industry has incurred a catastrophe to the environment. There is psychological pressure in the modern world that compels everyone to keep up with the latest fashion trends. The trend is furthermore fueled by advertisements and rapid economic growth, which has enabled people to spend even more money. The economic growth and people's ability to spend form a vicious cycle, intensifying each other where the feeling of flamboyance surpasses the feeling of necessity.

Now, the fashion industry has already held the title of one of the most polluting industries in the world. Almost everyone is aware of its tremendous negative impacts on the environment. A regular need to update the wardrobe for being in trend has made the bad situation even worse. A mass fashion cam-

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paign, performed by famous bloggers on social networking sites also puts their followers under pressure to copy their outfits. A failure to address such problems in their preliminary state could lead to irreversible damage to the environment in the near future. So, let's dig into this rabbit hole of the common polluter of the environment.

METALLURGICAL PROCESSES AND INDUSTRIAL PLANTS

Thallium is an extremely toxic metal (Liu et al., 2019a). It is used in the production of electronics, semiconductors, solar cells and in metallurgical processes as a catalyst (ATSDR, 1992). Thallium can be released into the environment from coal-fired power plants, cement plants, metal smelters, chemical plants and mining plants (for example, pyrite mining) (Campanella et al., 2016; ATSDR, 1992).

In the recycling plants and e-waste disposal areas in India, thallium levels in the air are about 20 times higher than usual (Ha et al., 2009). Similarly, it is widely accepted that China is the world leader in terms of copper production. Wang et al. conducted a study of the bottom of a lake located near a copper smelter in China and found that the lake had been subject to severe thallium pollution over the past 60 years. This may be due to the discharge of waste from the copper smelter, which contains thallium (Wang et al., 2019).

Another source of environmental pollution in China is the steel industry. In the area of the steel plant in Guangdong Province, in China, the thallium content in the river silt was 3-7 times higher than the maximum level (Liu et al., 2019). A Series of outbreaks of local pollution has been recorded in China, one of the reasons for which is also considered to be the metallurgical industry (Liu et al., 2018). In Guizhou Province, levels of thallium in the environment have also been found, which exceed the average background values in soils by about 40 times (and the maximum value is 130 times). This level of pollution is recognized as high (Jiang et al., 2019).

In Tuscany (Italy), increased content of thallium in groundwater was found. The source of pollution was found to be thallium-bearing ores in abandoned pyrite mining sites. Thallium levels in the urine and hair of the residents of this area correlated with the concentration of tap water (Campanella et al., 2016).

Marine thallium pollution is supported by a study in Indonesia, where elevated thallium concentrations were found in the skeleton of coral reefs near gold mining areas (Edinger et al., 2008). In the Polish city of Katowice, the maximum concentration of thallium in the air was exceeded by 660 times. This has been attributed to industrial dust and fumes (Karbowska, 2016).

Earth's crust consists of plenty of aluminium. It has found wide application in human activities: cans for drinks, dishes, foil, aeroplanes, cars, building materials, and fireworks. It is also used in medicine (antacids), industry ($AlCl_3$ as a catalyst) and water purification. It is included in pesticides, cosmetics and antiperspirants (ATSDR, 2008).

Elevated levels of aluminium in the environment can be associated with mining (including coastal) and processing of minerals, and the production of its alloys and compounds. Small quantities are emitted into the atmosphere from coal-fired power plants and incinerators. These actions can increase the concentration of aluminium in coastal waters, rivers and soil (ATSDR, 2008; Gillmore et al., 2016).

The aluminium level in the coastal waters of the United States (Florida Bay) was 0.8–16.7 μg/L (Caccia, Millero, 2003); in Australia – 1.3–5 μg/L with a concentration of 83 μg/L in industrial ports (Angel et al., 2012; Angel et al., 2016); in the UK - 1.4–2 μg/L (Upadhyay, 2008; Upadhyay, 2012). At the same time, the level of aluminium in the open ocean does not exceed 0.68 μg/L (Angel et al., 2016).

The highest levels of aluminium in wastewater have been found in areas where batteries and automobiles are manufactured. In all cases, levels exceeded the permitted level (Iloms et al., 2020).

In Bangladesh, a survey revealed an exceptionally increased level of aluminium in the rivers in the vicinity of Dhaka (capital of Bangladesh), and in urbanized and industrial areas. This confirms reports that industrial wastewater is discharged into the environment without pretreatment and treatment. At the same time, an increased amount of aluminium can spread downstream, polluting relatively ecologically clean areas (Rampley et al., 2019).

Arsenic is naturally widespread in the earth's crust but is toxic to humans and the environment. Its increasing level in the environment should be an urgent issue to be addressed. Most of it is released during the processing of ores containing lead, cobalt, gold or copper, where arsenic is a by-product. Thus, it enters the environment in the form of fine dust in the flue gases of the metallurgical industry or during the incineration of municipal waste (ATSDR, 2007). Arsenic compounds are widely used in human activities: they are used as antimicrobial additives in

animal and bird feed; herbicides, insecticides, pesticides (mainly for cotton); components of alloys (for example, in batteries for cars), semiconductors and solar cells (ATSDR, 2007; Järup, 2003).

Meshalkina's study noted that 5% of soil samples contain arsenic concentrations to a dangerous level near a sulfuric acid plant (Meshalkina, 1996). Similarly, Manay et al. did an analysis of the data and revealed that arsenic pollution in Uruguay is a serious problem. This is associated with the fact that the concentration of arsenic in the main water sources exceeded the permissible level set by the WHO (Mañay et al., 2019). Arsenic pollution is also common in other Latin American countries, especially Chile, Mexico, and Argentina (Bundschuh et al., 2012). In Brazil, there is a high concentration of arsenic in water (exceeds WHO standards by 5–290 times) and soils. Local fish and seafood are contaminated with this element and may pose a risk to human health (Baeyens et al., 2019; De Souza et al., 2018).

Groundwater pollution with this element is also an acute problem in Nepal (Terai region), where 23% of the sources had arsenic levels higher than the WHO recommendations (10 μg/L), and 5% of them had a level higher than the internal norms of Nepal (5 times higher, than WHO) (Shrestha and Maskey, 2002; Shrestha et al., 2003). In Bangladesh and West Bengal, detected arsenic concentrations in drinking water exceeded the permissible 50 μg/L in 59% and 34% of samples, respectively. It is noteworthy that in 8.7% of cases in Bangladesh and 0.9% in West Bengal, the values were 10 times or more exceeded (Chowdhury et al., 2000). A number of studies confirm the seriousness of the arsenic pollution problem in Bangladesh (Islam et al., 2018). In Pakistan, 73% of groundwater samples have arsenic levels that are 10 times the WHO limit (Shahid et al., 2018). It is also well-known that in the southern part of Thailand (Wattanasen et al., 2006), India (Chakraborti et al., 2018) and 19 provinces of China, the amount of arsenic in the environment exceeds the permissible limits by tens of times (Jia et al., 2018). The same is the case in the United States, where the area of abandoned mines had more than 100 μg/L of arsenic (Foust et al., 2004).

In Nigeria, the accumulation of arsenic in corn, peanuts, and spinach leaves in the area of waste dumps was noted (Opaluwa et al., 2012). It has been known that arsenic is able to be accumulated in rice, provided that its soil concentration is high (Williams et al., 2007; Awasthi et al., 2017). An important way of spreading arsenic is the ingress of dust with its content into the air and its subsequent precipitation with rain. For example, in Australia, it was found that the concentration of arsenic in rainwater is 3-55 times higher than the allowable amount (Chubaka et al., 2018). The level of arsenic in the air over Europe tends to decrease, but the values are still 2-3 times higher than the permissible levels (Jiřík et al., 2016). In a study in India, it was noted that human intoxication with arsenic increased with an increase in the frequency of fish consumption by the subjects. It is to be remarked that India is a highly arsenic-polluted region (Jose and Ray, 2018).

Mercury is used in industry and medicine (dental fillings, thermometers), which puts people working in these fields and those with amalgam fillings at a higher risk of mercury toxicity (Järup, 2003). The main food sources of mercury are fish and seafood (they predominantly contain methylmercury). It is also found in rice, green vegetables, and mushrooms (Zahir et al., 2005). It is noted that plants accumulate heavy metals, including mercury, when growing on soil that is poor in essential micronutrients (Gothberg et al., 2004). Mercury is also found in algae, especially when it comes to the market from the sea waters around Portugal and Spain (Bay of Biscay) (Paz et al., 2019).

In a study of Jose and Ray (2018), the concentration of mercury in the blood of vegetarians (0.66 ± 0.33 mg/L) was significantly lower than that of adherents of a mixed diet (2.12 ± 1.31 mg/L). The authors noted that the concentration of mercury in the blood increased with the increase in the frequency of fish consumption by the subjects (since the level of mercury is significantly associated with the presence of fish and seafood in the diet) (Kim et al., 2016).

COTTON

The garment industries frequently choose cotton as the first choice of their raw material for their manufacturing process. But the cotton cultivating procedure is quite resource-intensive and requires a lot of water and chemicals. According to the study done by Glynis Sweeny, cotton covers only 2.4% of the total cropland but consumes 10% of the agricultural chemicals and insecticides (Sweeny, 2015). China, as in other industries, is the leader in the cotton-producing industry. Other countries like India, the USA, Uzbekistan, Brazil and Pakistan also produce cotton, following just behind China. It is clear that cotton has seen its market in every corner of the world.

Uzbekistan holds the title of the 6th largest cotton producer in the world. The record has cost Uzbekistan a huge price in terms of the environment

and now serves as a perfect example on how cotton production could degrade the surroundings (Aliyeva, 2018). For irrigation purposes, the two central Asian rivers – "Amu Darya" and "Syr Darya" were diverted from the Aral Sea. These rivers provided the necessary water for producing cotton in Uzbekistan and Turkmenistan. In the process of irrigating cotton plants, the Aral Sea is now left with only 10% of its original volume of water in just 50 years (Map of the dynamics of the Aral Sea from 1960 to 2015, 2018).

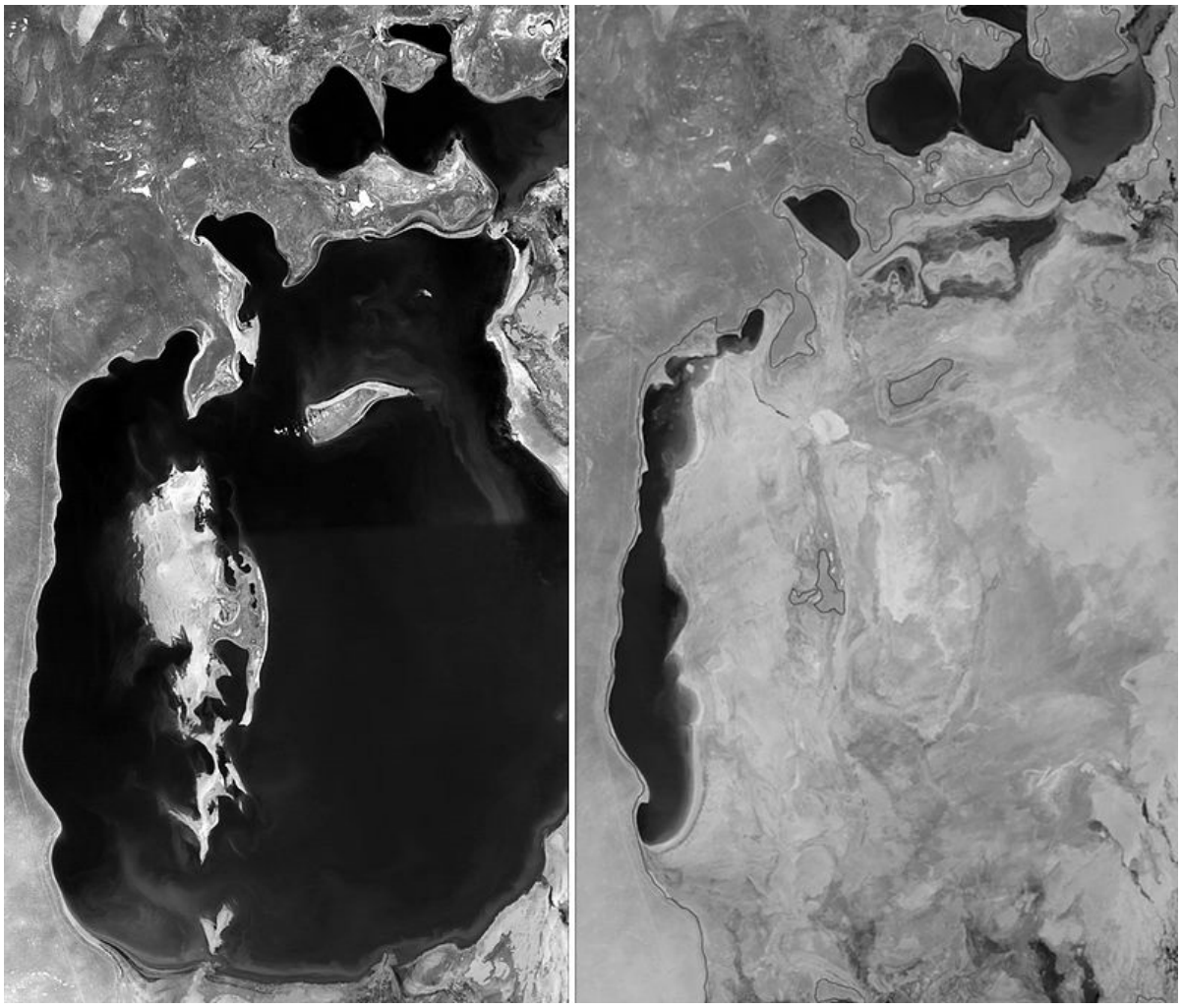

Image 1. *The shrinking Aral Sea (Breckle and Geldyeva, 2012)*

Image 2. *Citarum River. A villager navigating his way through heavily dye-polluted water (Ksumadireza, 2018)*

The decreased water level put forward a number of consequences and made the local inhabitants wary. One of the consequences is that the fertilizers and pesticides used in the crop field began to contaminate the sea and oversalinated it. One of the unprecedented ramifications of the decreased water level of the Aral Sea is a dramatic change in the climate. Each year, the residents have been noticing extreme temperatures in the summer and winter seasons because the decreased water level of the lake couldn't counterbalance the extremities (Sakiev et al., 2015).

DYES

Dyes are manufactured and used almost everywhere, but Indonesia is probably most seriously hit by its dye industry, especially the Citarum River. Since all the textile companies dump their byproducts directly into the river, the Citraum River has become one of the most polluted rivers in the world (Tarahita and Rakhmat, 2018). With the polluted river, the lives of almost 5 million people living near the river bank are at risk. Similarly, animals also consume the same contaminated water, which is threatening wildlife. Initially, the weak regulations allowed the manufacturers to dump their wastes into the river because nobody thought about the deep effect it could have in the future (Handbook of Textile Effluent Remediation, 2018).

A test result of a sample of water from the polluted river revealed a disheartening result. It was full of nonylphenol which could easily kill all the aquatic forms of life. The water was described as highly caustic and could deteriorate aquatic life and even could burn human skin (Soares et al., 2008).

Nonylphenol is found not only in the Citarum River but also in various household things like oil additives, dish and laundry detergents. Nonylphenol consists of a group of organic compounds which is also used in the antioxidant manufacturing process. They are especially more toxic to aquatic organisms due to their bioaccumulative property (National Center for Biotechnology Information. PubChem Database, 2020). If the chemical is used in the garment industry, it can cling to the clothes even after a few washes and keep on harming human health till it has been completely removed. That's why the European Union has prohibited nonylphenol ethoxylates containing garment products into its territory (Government Chemist and Environment Agency, 2015).

Another element that is used to make the dye is tin. Its organic compound is mainly used for antifouling paint for ships, but, besides it, it is also a key constituent of cans, aerosol cans, and toothpaste and is present in many alloys and materials, and in the glass industry (ATSDR, 2005). Its concentration in the environment increases during extraction, processing and recycling. They can also be decomposed by bacteria and sunlight, releasing inorganic tin into the environment (ATSDR, 2005). The tin derivatives were widely used in the 1960s-1980s as antifouling paints for ships and its consequences can still be in the skeleton of a coral (Micronesia) (Inoue et al., 2004). Similarly, it was found that there was a toxic effect on shell formation and growth of oysters and molluscs due to the accumulation of organic tin derivatives in them (Díaz et al., 2007; Tang et al., 2010; Sebesvari et al., 2005). The concentration of tin in the soil in a national park in Spain is 14 times higher than the background average. The reason for this may be human activity due to uncontrolled soil fertilization and diffuse environmental pollution (Jiménez-Ballesta et al., 2016). In Germany, this difference was 3-22 times (Rinklebe et al., 2019).

Lead is also the next toxic component of the paint and pigments. Other felids, where lead can be used are rechargeable batteries, pesticides, plumbing, cosmetics and military products (ATSDR, 2019). An important derivative of lead, that pollutes the environment is tetraethyl lead, which is produced as exhaust gases when using leaded gasoline (Skalny and Rudakov, 2004). Major environmental hazards are posed by large landfills, including those containing lead, in countries such as Tanzania, Kenya, Senegal, Nigeria, Indonesia, Philippines, India and Pakistan (Blacksmith Institute, 2010). A study in Hong Kong found that average lead concentrations in soil and grass near highways are 991 μg/g and 134 μg/g, respectively. The level of pollution along the carriageway was proportional to the amount of traffic on these roads (Ho and Tai, 1988).

A similar pattern was observed in Bangladesh (Naser et al., 2012). China also suffered from excessive amounts of lead, especially in economic zones such as Shanghai and Guangzhou (Duan et al., 2016). In the same way, In Nigeria, the concentration of lead in agricultural soils in some states exceeded acceptable levels. The highest levels of this element were found in rice and local pears (Orisakwe et al., 2012). Lead in spices (such as chilli peppers, nutmeg, and some typical local spices) was 8 to 30 times higher than acceptable limits (Asomugha et al., 2016). It is noteworthy that the concentration of lead is higher in areas involved in oil production, which is reflected in its accumulation in plantains and cassava (Alum et al., 2014). Similarly, a high

concentration of this heavy metal was found in the Turag River, along the banks, where metallurgical, textile, pharmaceutical and food industries were prominent (Aktar and Moonajilin, 2017).

CONCLUSION

In short, the process of extracting the metals from their corresponding ores should be on par with high standards of safety, else the pre-existing niche of high toxic areas can spread its territory, leading to the ultimate fatality to human beings. The legislation should enforce the proper regulation of these industries. On the other hand, each one of us can also play a vital role in controlling pollution. For instance, it is not necessary to buy an extra pair of jeans that you may not need. If the consumer's demands decrease, so do the cotton industry, which could spare extra water and extra field to grow more productive agricultural products.

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Conflict of interest

Authors declare no conflicts of interest.

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ЭКОЛОГИЧЕСКИЕ ПОСЛЕДСТВИЯ ЧЕЛОВЕЧЕСКОЙ БЕЗОТВЕТСТВЕННОСТИ
ЧАСТЬ II: ПРОМЫШЛЕННЫЕ ОТХОДЫ И УГРОЗЫ ВОДОЕМАМ И ВОДОТОКАМ

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РЕЗЮМЕ. Хорошо известно, что люди находятся в процессе быстрой модернизации мира, используя различные природные ресурсы с беспрецедентной скоростью. Поначалу это достижение может быть ошибочно принято за великое достижение человека, но в ходе этого стремительного развития мы оказывали дополнительное давление на окружающую среду, особенно за счет утилизации вредных промышленных химикатов. Во-вторых, мы, люди, также чрезмерно используем ограниченные источники природы, что приводит к ее истощению, в конечном итоге прерывая естественный цикл. Металлы являются незаменимым сырьем для строительства инфраструктуры и производства электронных продуктов. Однако извлечение металлов из соответствующих руд может привести к серьезным последствиям, если не будут приняты меры предосторожности. Точно так же постоянно меняющаяся индустрия моды экспоненциально повысила спрос на хлопок, что в конечном итоге побудило людей еще больше эксплуатировать природные ресурсы, такие как вода, что привело к изменению климата и даже в некоторых случаях к высыханию всего моря. Эти действия также представляют огромную угрозу для окружающей среды, в которой мы живем, и человеческого существования. Из-за невнимательности человека концентрация вредных химических веществ в воде, почве и воздухе во многих регионах уже намного превышает допустимый верхний предел. Недопустимо высокие уровни вредных химических веществ напрямую влияют на здоровье не только людей, но и всех живых организмов, живущих на Земле. Если этот процесс не остановить вовремя, мы, люди, вместе с дикими животными и невинными организмами будем вынуждены заплатить огромную цену.

КЛЮЧЕВЫЕ СЛОВА: загрязнение, хлопок, краски, таллий, алюминий, мышьяк, ртуть, олово, свинец.