Impact of The European Green Deal on pollution reduction in textile industry with an emphasis on textile finishing

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The paper covers the global issue of pollution reduction with an emphasis on the textile industry. The European Green Deal elaborates the issues by which can deminish environmental, water, air and soil pollution by 2050. The EU Green Deal clearly highlights the link between the circular economy and the environment. There are more ways in which man has a negative impact on the environment, and it was necessary to develop a strategy and action plan to ensure zero levels of pollution. One of the important goals is to reduce the depletion of forests, water and soil, in order to preserve the sustainable development of the ecosystem. From the point of view of reducing the pollution, the problem of the textile industry is extremely important since it is one of the major industrial polluters. The paper lists the most commonly used contaminants that cause pollution in general and in the textile industry in particular. Additionally, solutions for cleaner production are presented. They include the use of environmentally friendlier agents and devices, highly efficient procedures and maximum utilization of each raw material, with the highest possible degree of reuse, recycling, composting, energy recovery and finally proper disposal which does not harm the environment.

Key words*: The European Green Deal, pollution reduction, textile finishing, high performance technologies*

1. Introduction

The latest European Environment Report [1] states that our well-being and a healthy environment come from an innovative, circular economy in which almost nothing is lost. Natural resources are managed in a sustainable way, while protecting, valuing and maintaining biodiversity at the same time. Only by reducing CO_2 emissions can a secure and sustainable global society be achieved. The European Commission presented The European Green Deal [2] and provided a clear Action Plan until 2050 to reduce environmental, water, air and soil pollution to zero levels in order to protect European citizens and ecosystems, stimulating the economy at the same time. The action plan includes the conservation of biodiversity in lakes, rivers and wetlands, the reduction of particularly harmful pollution caused by microplastics and pharmaceuticals, the reduction of pollution caused by excess nutrients, and the use of pesticides and fertilizers through the strategy "From the field to the table" [3]. As far as air is concerned, it is important to review air quality standards in accordance with the guidelines of the World Health Organization (WHO) and to provide support to local authorities in providing cleaner air for the citizens of the European Union. Furthermore, it is necessary to increase the prevention of industrial accidents and reduce pollution from large industrial plants. Finally, the protection of citizens from hazardous chemicals is very important, and the new Sustainability Chemicals Strategy seeks to reduce the negative impact on the environment, encourage the development of more sustainable alternatives, and better link healthcare to the growing global competitiveness and improve the rules for assessing the safety of substances placed on the market. In this way, harmony in accordance with sustainable development should be achieved by 2050. All these measures aim at one thing, to make Europe the first, climate-neutral continent [4].

2. The importance of biodiversity for economic development

The biosphere is a part of the Earth inhabited by living beings, and consists of aquatic and terrestrial biomes characterized by biological diversity. Biodiversity is defined as variability, ie diversity between living organisms. This diversity includes differences within species, between different species and between ecosystems. An ecosystem is a dynamic complex of communities of plants, animals, microorganisms and the inanimate environment in an area that is defined by certain dimensions. Examples of dimensions are taxonomic diversity, phylogenetic diversity, functional diversity, diversity of interaction and diversity of landscape. Ultimately, one ecosystem acts as a perfect whole of biologically diverse but interdependent organisms. The ecosphere represents the next level, and is defined as the set of all ecosystems on Earth. It is very important to pay attention to the interaction and interdependence between all living beings, ie all components of the ecosystem in a given space, with the purpose of sustaining life on Earth. Interaction, which is necessary on the one hand, can be disastrous on the other hand, because if one component of the ecosystem has a negative effect on the environment, all other components will be affected. Approaches based on ecological acceptability use solutions based on nature. One example is the effort to mitigate the negative effects of climate change by preserving or increasing carbon stocks, thus increasing the resilience of ecosystem components.

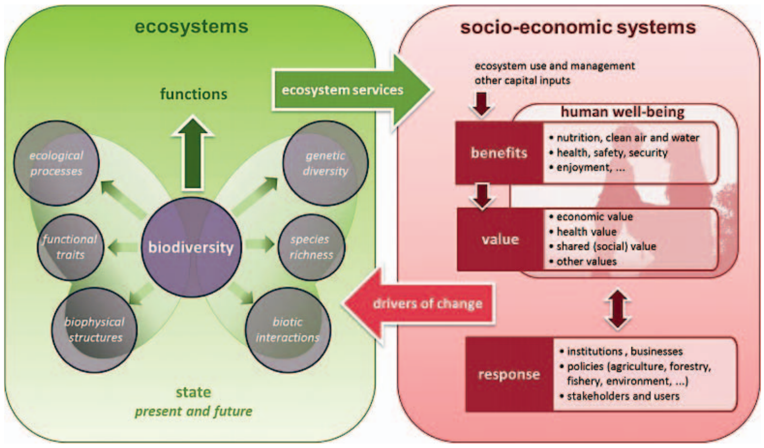

Fig.1 Relationship between ecosystem and socio-economic systems [6]

Strategies that apply biodiversity and ecosystem services are part of Green Infrastructure, which is the overall strategy for environmental protection. Ecological networks are also part of the Green Infrastructure, and show biotic interactions in the ecosystem. As with all infrastructures, national bodies play an important role. They define clear guidelines on the planning and implementation of directives, which are forwarded to the local level, ie to the local development of a country. The role of regional or local authorities is important because in most European countries they are responsible for spatial planning decisions, where different fields such as environmental, planning, agricultural and social, should be working together. Local authorities are considered to be the leading organization that carries out detailed planning of Green Infrastructure depending on their location, limitations and priorities. A good example of an EU country is Denmark, which already in 2008 adopted a national strategy on climate change [5]. Denmark's strategy describes in detail how it will contribute to climate change mitigation, and notes that economic analysis will be needed in certain areas, including:

- Cost-benefit analysis of promoting one's own adaptation to climate change through planning and regulation. This will result in less fragmentation, ensuring a growth corridor and reducing the number of existing stressors;
- Adaptation to climate change for the protection of nature and the environment in sectors that are important for nature. These are agriculture, forestry and coastal management;
- Determining the price of a certain number of goods and services from nature that do not have a direct market value. This refers to the reduction of air pollution, water purification, soil conservation and models for calculating the socio-economic benefits and costs of nature management.

Biodiversity is the extraordinary diversity of ecosystems, species and genes found in the environment. It provides life support for the human population, provides food, fresh water and clean air, shelter and medicine, and contributes to climate regulation. Nature is undoubtedly value and capital, and the development of service activities in nature supports the economy. Ecosystem services reach a value of one trillion euros. The deterioration and loss of ecosystems threatens the provision of these services, the reduction of biodiversity, ie the loss of species. In addition, it affects the loss of jobs related to nature, which endangers one's own well-being [6].

Fig.1 shows the relationship between the ecosystem, society and the economy. The most important global threat to the environment is the loss of biodiversity along with climate change, which is inextricably linked. Although biodiversity is a key contributor to climate change mitigation and adaptation, achieving the two-step goal, together with appropriate adaptation measures to reduce the impact of the inevitable effects of climate change, is also important to prevent biodiversity loss.

Unfortunately, current species extinction rates are high, mainly as a result of human activities. Species are currently losing 100 to 1,000 times faster than the natural rate. According to the Food and Agriculture Organization (FAO) 60 % of the world's ecosystems are degraded or unsustainably exploited, 75 % of fish stocks are overexploited or significantly depleted, and 75 % of the genetic diversity of agricultural crops in the world has been lost since 1990. It is estimated that 13 million hectares of tropical forests are destroyed each year, and 20 % of tropical coral reefs have already disappeared. In the EU, only 17 % of habitats and species and 11 % of key ecosystems are protected by legislation. Indirect drivers, such as population growth, limited awareness of biodiversity and the fact that the economic value of biodiversity is not reflected in decision-making, also have a significant impact on biodiversity. To prevent biodiversity loss, the EU's 2010 biodiversity target was set in 2001. In March 2010, EU leaders recognized that the 2010 biodiversity target would not be met despite some major successes, such as the establishment of Natura 2000, the world's largest network of protected area.

They therefore supported the long-term vision and ambitious headline target proposed by the Commission in its Communication "Opportunities for an EU vision and a biodiversity target beyond 2010" [7]. Subsequently, the European Biodiversity Strategy until 2020 was published [8], and in 2017 the Croatian Parliament adopted the Strategy and Action Plan for Nature Protection of the Republic of Croatia, which implements measures in line with EU recommendations [9].

As far as ecosystems and biodiversity are concerned, Croatia is extremely rich in natural resources. The obligation of all Croatian citizens is, above all, to preserve natural resources and encourage sustainable development. The biggest problem that arises is waste recycling. Although the average Croatian citizen creates less waste compared to the citizens of most European countries, only 21% of waste is recycled. Thus, proper waste management today requires full commitment for the purpose of achieving a circular economy.

In accordance with The European Green Deal strategy until 2050 biodiversity and natural resources, as well as the ecosystem services themselves, must be protected, valued and restored. Through these actions, ecosystems could return to their original undamaged state with preserved biodiversity that would contribute to the progress of society [7].

The European Green Deal and related actions can only be achieved through the synergy of countries within the EU. However, Europe's action alone, in the form of reducing environmental pollution and launching a circular economy, is not enough either, as the causes of climate change and biodiversity disruption are a global problem. Therefore, the global participation, especially of those that lead in the amount of pollutants, is needed in order for the world to reach a state of sustainability. EU member states are countries of exceptional expertise and economic strength, so their role in sustainable development is significant even beyond the EU borders. This refers to the possibility of creating alliances with other countries in the world in order to improve the current state of the environment [2].

3. Impact of the pollution on the environment

3.1. Air pollutants

Substances that are in the atmosphere and chemically do not belong to the composition of air are called polluted air. Today, it is difficult to find an area where the air is equal to natural composition, ie that it is not polluted. Air is shown to be particularly polluted if it contains substances in concentrations that can cause harmful effects on human, plant and animal health and if it harms the environment. Substances such as suspended particles (sea salt, black coal, dust and particles of certain chemicals) can have a serious impact on human health. Air pollution can cause various diseases such as respiratory and circulatory diseases and other chronic diseases.

Air pollutants can be classified into two groups [10]:

- primary pollutants that create and release their harmful products directly into the atmosphere,
- secondary pollutants formed from primary pollutants in two ways: in interaction with each other or in interaction with common atmospheric substances (eg acid rain formed by the reaction of SO_2, NO_2 and NO_3 gases and water).

Sources of pollution are very different, and are divided into local and global. Local pollution is related to cities and some larger industrial areas, but often local pollution can be transferred to the global level. Wind can spread harmful substances from the

Tab.1 Overview of harmful effects caused by various pollutants in water [16]

Type of pollution waste water	Harmfull consequences	Realized social benefits from wastewater treatment
Large solid material: fabrics, plastics	Untidy landscape; hazards to human and animal health	Shores, rivers, lakes, the sea and their surroundings become safe for work and recreation
Organic matter: food waste, faecal matter, non-toxic industrial wastewater	The presence of bacteria and other higher species of the aquatic world reduces the amount of dissolved oxygen in the water, which can lead to the death of fish and other organisms, and in general to the disruption of the food chain.	Protection of fisheries and sport fishing; a more pleasant environment for living, working and recreation
Organic substances: oils and fats	A dangerous thin impermeable layer forms on the surface of the water, which reduces the possibility of oxygen absorption from the atmosphere.	Improved dissolution of oxygen in water helps maintain aquatic flora and fauna
Nutrients: nitrogen, phosphorus and traces of harmful substances	They act as fertilizers that stimulate the growth of algae, seaweed and other aquatic plants	Improved and safer conditions for fish and shellfish farming; more pleasant environment for life, work and recreation
Bacteria and viruses	Pollution of water used for water supply or irrigation of agricultural land	Safer general health conditions for shellfish, fish and other organisms
Toxic substances from industrial wastewater	Occurrence of destruction or damage to aquatic flora and fauna; accumulation of harmful substances in the meat of fish and shellfish, can have a detrimental effect on human health	Improved living conditions for aquatic flora and fauna; improved general and health conditions

place of origin very easily and over the long distances. The main sources of air pollution are divided into those of natural and anthropogenic origin. From natural sources, volcanoes play an important role in polluting the atmosphere, emitting a significant amount of various gases and particles of dense volcanic dust during eruptions. There are about 700 active volcanoes on Earth. Numerous eruptions during the evolution of the Earth can disrupt the chemical composition of the atmosphere, both locally near volcanoes and at greater distances. Anthropogenic influences are those that arise from the action of humans on the environment. Man's action began to seriously disrupt the chemical composition of the atmosphere. Significant amounts of different gases, aerosols and dust from different sources are released into the air. The most common gases released into the atmosphere by human activity are: sulfur dioxide (SO_2), carbon dioxide (CO_2), ozone (O_3), nitrogen oxide (NO), nitrogen dioxide (NO_2) and hydrocarbons (CHX). These gases are most often found in the flue gases of the chemical or some other industries in tthe form of gases, vapors and aerosols. They can also be formed in the processes of burning fossil fuels in households or vehicles [10].

The textile industry is also one of the major polluters of outdoor and indoor air. The emission of harmful chemicals and textile dust harms not only workers but also the surrounding population. Due to poor ventilation, workers in textile factories are at high risk of inhaling textile dust that can cause diseases such as bisynosis (a disease that causes narrowing of the airways), respiratory problems and asbestosis. There are often problems with exposure to various metal vapors, such as chromium [11], acid and base vapors, boiler room gases, oil vapors and volatile organic carbon compounds (VOCs) [12]. In addition, in third world countries such as Bangladesh, gases which pose a major threat are nitrogen and sulphur oxides. Hassan et al. have concluded in their research that these gases pose the greatest threat to the population living near textile factories [13]. Several steps need to be taken to reduce the potential danger to human health. In his paper [14], Müezzinoğlu stated that pollution reduction can be achieved by reducing or preventing:

- emissions of dust and short fibers,
- direct emissions of harmful gases,
- use of harmful volatile chemicals,
- excessive use of energy.

However, it should also be noted that the use of electrostatic precipitators, condensers, and a ventilation system and an adequate system for exhausted air ejection, both indoor and outdoor air pollutions can be drastically reduced [12].

3.2. Water pollutants

The main causes of water pollution are considered to be harmful substances found in untreated wastewater from industry and households. They are mostly caused by excessive use of fertilizers and poisons in agriculture, asphalting and concreting, deforestation, losses in the water supply system, negligence, etc. Urbanization has a particularly strong impact on the ecosystem causing enlarged human communities, population growth and its concentration in large cities. As a result, the amount of wastewater has increased significantly. At the end of the 19th and the beginning of the 20th century, more frequent use of water took place, and as a result of industrial production water pollution occurred. Two billion people are deprived of basic sanitation units, and the problem of drinking water pollution is affecting more and more countries, not only developing ones but also many developed countries. It is estimated that 4,000 people die daily from diseases caused by consuming polluted water [15]. Table 1 shows some water pollution, their harmful effects on the environment, people, plants and animals, and the benefits of wastewater treatment.

The textile industry is at the top of the world list of wastewater producers. Textile finishing processes result in very high water consumption, which is being reduced by various solutions such as reducing the bath ratio and regenerating wastewater from the process.

Water pollution in the textile industry is primarily caused by impurities arising from the process of textile production, inparticular from textile finishing. Impurities are separated from the textile material, and the main causes of pollution are chemical agents used in the processes of textile finishing, aftertreatments, rinsing or washing. The most significant contaminants occur during the wet processes in particular during the pretreatment processing. It is important to note that the values of COD (chemical oxygen demand) and BOD (biochemical oxygen demand) increase with increasing wastewater pollution [17].

More than 80 % of the world's wastewater production originates from the wet processing. On average, about 150 m^3 of water per ton of treated material is used for the dyeing process alone. Today, the textile industry uses more than 3,600 different dyes and 8,000 chemicals, many of which pose a threat to human health and endanger the environment. Textile factories with an average processing capacity of 8,000 kg of fabric consume up to 1.6 million liters of water per day. Raising awareness of environmental issues has led to a strengthening of the regulations for the textile industry in relation to the amount of wastewater it produces and its purification. Efforts are being made to reduce wastewater production and advocate for the regeneration of wastewater from the process in order to make the most of it. Of course, such adaptations take time and financial resources to adapt textile factories and join the global movement to reduce water pollution [18].

3.3. Soil pollutants

Some of the sources of soil pollution are urban areas, agriculture, industry, incidents, atmospheric deposition or natural phenomena. Contaminations and damage of the soil, unlike air and water, are not so much covered in public. Various studies revealed that almost one third of the total soil is contaminated. Soil pollution occurs through the modernization of society and industrialization. It changes the composition and structure of the soil, and these changes significantly affect the development of flora and fauna. It can be caused by direct contact between the contaminated object and the ground or by direct contact with an "intermediary" or "carrier". Forests are the foundation of the bioproduction system and they are the source of many important raw materials - fuels, building materials, minerals. They are especially important because they protect the soil from erosion and regulate water balance and climate. From the examples of bare slopes of the Himalayas and the Andes, it is clear how much the destruction of forest areas affects the soil causing erosions, large deposits of mud and floods.

In the case of the textile or other industries, the direct discharge of wastewater into the soil can be extremely harmful. Especially when the released substances from the soil get into the water. Due to the pollution that often contains colloidal substances in a mixture with dyes and various fatty substances, watercourses become turbid, sunlight penetrates less through the water mass, reduces the process of photosynthesis and thus growth of aquatic plants. This disrupts the oxygen transfer in water-to-air relation. In addition, when these types of wastewater come into contact with dry soil, they practically destroy it, clogging the pores in the soil which is no longer productive, ie suitable for the plant growth. The texture of the soil hardens and becomes less permeable, thus preventing the penetration of water to the roots of the plant [19].

4. The importance of The European Green Deal for the textile industry

4.1. Problems of the textile industry

Most textile processes, from the processing of fibers, production of flat textiles, dyeing and finishing, till confectioning can have negative impact on the environment. Figure 2 shows emissions/releases from the complete textile production process. Special attention is paid to the negative influences of conventional wet finishing processes which include pretreatments, dyeing and printing, so as textile finishing. Large amounts of consumed clean water, energy and a wide range of chemicals (acids, salts, alkalis, textile auxiliaries, dyes, finishing agents) place the textile industry at the very top of water-polluting industries. In addition, 20-25 % of the total world production of chemicals is used in textile finishing processes. Textile wastewater has high values of chemical and biochemical oxygen demand (COD and BOD), contains large amounts of total dissolved solids (TDS) or total suspended solids (TSS), often is colored, has elevated temperature, wide range of pH values depending on the processing, and often contain substances that are hardly biodegradable (synthetic dyes, pigments and textile auxiliaries) and in some cases also contain heavy metals.

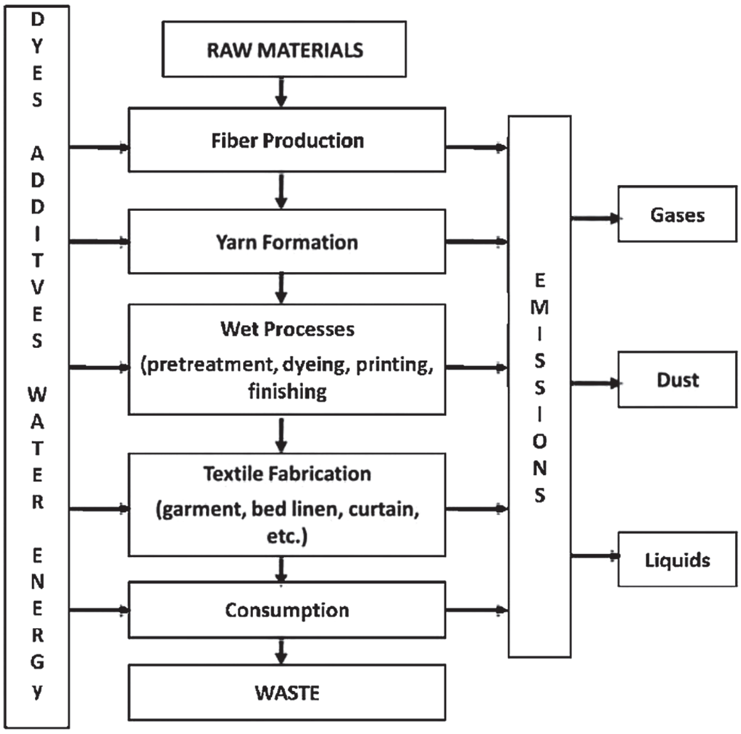

Fig.2 Scheme of raw materials and emissions into the environment during the textile production stages [20]

Textiles and textile products are characterized by a very large variety, both in terms of raw material composition and types of finishing. There are numerous finishes for textiles, eg UV protection, antimicrobial protection, water repellency and oil repellency, flame retardancy, treatments to obtain a soft feel, for easy care etc. These finishes consume a large number of chemicals, active and auxiliary agents, as well as large amounts of water and energy. Numerous chemicals used in textile industry are potential water pollutants. Examples of such compounds are formaldehyde-containing agents, non-degradable additives, toxic biocides, fluorine-containing compounds, organo-phosphorus flame retardants, polysiloxanes, fluorocarbon resins and cationic surfactants. From the environmental point of view, the discharge of textile wastewater with various harmful components such as chemicals, heavy metals, dyes and auxiliaries, directly to water flows leads to water quality reduction, eutrophication, imbalances in the aquatic ecosystem and consequently to biodiversity reduction [20]. So, it is evident that before discharging industrial wastewater needs to be pretreated in order to reduce or completely prevent harmful effects on the environment. Tab.2 shows the negative and unsustainable impact of the textile industry, which should certainly be avoided. In addition to the impact of the textile industry on the environment, it also affects the society. The major societal problem of the textile industry is in the low wages. The amount of wages in textile sector is lower than the average wages in most countries. In addition to low wages, the sector is characterized with poor working conditions, insecurity at work, excessively long working hours and child labor. As some countries do not give the right to workers to form unions, these poor working conditions are difficult or almost impossible to be improved.

The lack of fair trade is another negative feature [21]. This primarily applies to developing countries, where producers are prevented from stable production and fair trade in textiles. It is a movement that seeks to reduce the disadvantages of poor communities in the international market with the aim of reducing poverty globally while promoting sustainable development, social justice, better working conditions and wages [22].

In addition to the above, hot topic is microplastic which presents a global problem of water system pollution. In The European Green Deal, it is especially emphasized as a very harmful pollution, both for animals and humans. Microplastics can be defined as

Tab.2 Negative impact of the textile industry on the environment [21]

Impact of the textile industry on the environment
Impact on climate change • Burning fossil fuels to obtain the electricity
Toxic chemicals • Fertilizers and pesticides • In production phases such as fiber extraction, dyeing, refining and printing
Textile waste increase • Highly biodegradable waste • Large amounts of waste due to the rapid change of fashion trends
Water usage • Usage of large water amounts eg for cotton growing, textile finishing, dyeing and care
Non-renewable raw materials • Fossil fuels (coal, oil, gas) used as main raw materials in the production of synthetic fibers
Occupying space • Large fields for growing fiber or breeding animals can ocupied space needed for food production

Fig.3 Hierarchy of waste management available under the Creative Commons Attribution 4.0 International (CC BY 4.0) licence (https://creativecommons.org/licenses/by/4.0/) at https://ec.europa.eu/environment/topics/waste-and-recycling/waste-framework-directive_it

"particles smaller than 5 mm" although some scientists state their size can be less than 1 mm. Due to its small size, but also its different chemical composition, microplastics present huge problem for marine fauna. Namely, during digestion, particles can lag behind in the tissues and organs of animals and cause problems, such as cancer or sterility, which leads to significant variability between species [23]. Due to the rapid growth of plastic use in the last 60 years, and due to unintentional plastic pollution, microplastic particles now cover the seabed. L. van Cauwenberghe et al. state that in some parts of the seabed or the bottom of the lakes, there is minimally 1 particle per 25 cm^2 [24]. M. Sighicelli et al. stated that the cause of uncontrolled pollution of rivers is the direct discharge of sewage, but also contaminated industrial water [25]. In order to reduce the destructive impact of microplastics, significant measures need to be implemented, such as the prevention of pollution of rivers and lakes by wastewater treatment; by reducing and preventing pollution caused by fishing nets, buoys, ship waste, etc., or by reducing plastic waste and recycling [23]. However, microplastics are not only a problem for the environment and animal health, but it is equally dangerous to human health. Namely, the high risk of inhalation of microplastic particles is, according to J. Gasperi et al. [26], exposed workers in the textile industry. Because dust from artificial synthetic fibers, such as PA, PES, PE, PP, PAN, etc., as well as the fibers themselves, are not soluble in extracellular lung fluid, they lag in the lungs and cause a number of problems such as respiratory irritation, the appearance of cough, dyspnea and decreased lung capacity with the appearance of symptoms of allergic alveolitis. It is assumed that, as with asbestos inhalation, microplastic particles in the lungs can cause fibrosis and cancer.

4.2. Pollution reduction in textile finishing processes

4.2.1. Cleaner production

Waste from the textile industry, as well as from other industries, should be managed as shown in Fig.3. An unavoidable and most important step in the waste management hierarchy is the landfill. Unusable waste is disposed of in a sealed landfill and neither create unpleasant odors nor is dangerous for groundwater or humans. It would be ideal to produce as little waste as possible, properly sort it, reuse, recycle or recover the biggest part and dispose it separately if it is not possible to re-use it completely [27]. Fig. 3 shows how it is necessary to plan in advance, ie reduce waste at the source, which is called cleaner production.

Cleaner production is a proactive environmental strategy, ie a strategy of continuous application of environmental protection in order to, ultimately, prevent pollution and minimize it. The purpose of such a strategy is to improve overall efficiency, profitability and competitiveness, so as to protect workers health, ensure safety of workers and consumers, and generally reduce the negative impact on the environment while improving the life cycle of products. The highest priority is to reduce the use of water and raw materials, together with the reduction and disposal of waste. The economic measures defined in The European Green Deal seek to achieve cleaner production within environmentally unfriendly textile industry. Therefore, it is necessary to plan the production and methods of wastewater treatment, and to develop a comprehensive integrated approach to the problem of pollution. The first step in introducing cleaner production is to review all existing process technology and assess each process, processing order and equipment used to make it clear what is being handled well and what needs to be improved, or what creates the most environmental problems. Primarily cleaner production refers to adequate storage and handling of textile materials and chemicals, pipe insulation and improving the control of the process itself. Cleaner production activities include an ecological approach to production, which refers to the recovery of chemicals and return to the process, as well as the reduction of energy and water consumption for certain processes. Huge problem of textile industry is variety of the applied chemicals and the large amounts of water, so within The European Green Deal measures, the most attention is paid to these issues. Therefore, the main goal is to optimize the process by reducing processing time, using one bath to achieve multifunctional textile finishing and the introduction of highly efficient textile finishing processes.

4.2.2. Measures to introduce cleaner production in textile finishing processes

By reducing water consumption and recuperating chemicals, the costs of finishing, wastewater treatment, heat and electricity consumption are reduced. Water consumption in finishing processes can be reduced by applying smaller bath ratios in different machines [28]. In the process of dyeing hydrophobic fibers the supercritical CO_2 can also be applied instead of the water media. In general, the process of dyeing hydrophobic fibers uses high bath ratios and many chemicals (including the carriers) due to the more difficult bonding of the dye to the fiber. Therefore, supercritical CO_2 is an excellent alternative to conventional dyeing because no water or auxiliaries are used in such a process. In addition, no drying of the material is required after the process, which greatly reduces the amount of energy used [29, 30]. Most of the chemicals used in the finishing processes can be recovered and reused in the production process. NaOH can be recovered from the mercerization or any other finishing processes. Dyes and auxiliaries eg. NaCl and Na_2SO_4 from the dyeing process, so as starch, polyacrylates and polyvinyl alcohols (PVA) can be recovered from the starching process. Lanolin, which can serve as a raw material in many industries, is a by-product of raw wool fleece washing process [31]. There are possibilities for reuse of water after the treatment process, eg in the process of bleaching, dyeing, washing and rinsing of materials. After the finishing process, water is most often purified by reverse osmosis or membrane processes (ultrafiltration and nanofiltration) and, as such, is reintroduced into the process [19].

N. Eerdumlu et al. they explored the possibility of reusing wastewater from various breeding processes to bleach cotton [32]. Their results proved the possibility of reusing wastewater for cotton bleaching without affecting the process quality. It was concluded that the reuse of wastewater leads to water savings and reduced energy consumption. In this study, the microfiltration process was used, which is the cheapest option compared to other membrane processes to remove dyes and reduce the chemical oxygen demand (COD) value of water. There is also the possibility of using advanced membrane technologies that could be used to soften water, reduce electrical conductivity, COD values and remove dyes at once. However, these advanced technologies require higher investment costs, which is why zeolite was used in this study to decrease water hardness and reduce the electrical conductivity of wastewater. Zeolite is a natural mineral that is widely available and affordable. This research shows that wastewater can be reused for finishing processes without excessive treatment costs, which ultimately ensures economic, environmental and energy viability. In addition to recuperation and re-use of baths, the use of less toxic chemicals than those currently in usage in processing of cotton materials (eg cultivation of organic cotton without pesticides, use of biodegradable surfactants in treatments, use of H_2O_2 instead of chlorine-based oxidizing agents in the bleaching process and/or use of peracetic acid instead of Na-hypochlorite, reduction of auxiliaries amounts and use of environmentally friendlies ones and use liquid ammonia instead of sodium hydroxide in the mercerization process). In addition to such adequate substitutions of chemicals and ecological improvement of the already existing process, there are also newer technologies for the processing of materials such as biotechnology and nanotechnology. The implementation of biotechnology introduces enzymatic agents into processes instead of toxic chemicals (eg α-amylase, pectinase, lipase, glucose oxidase, catalase) [33-35]. Tab.3 shows the types of enzymes and their application in various textile finishing processes.

One example of the development of alternative solutions to reduce pollution is the application of plasma technology. It modifies the surface of textile materials, which significantly reduces the amount of water and chemicals required for pre-treatment or final finishing of materials [36]. This makes plasma technology energy and environmentally friendly. The action of plasma on a textile surface can be described by the reactions of cleaning, etching, activating or polymerizing the surface. Depending on the desired effects and the properties of the textile substrate, the parameters of the plasma are adjusted - the type of gas used, pressure, operating frequency, processing time [37, 38]. Plasma achieves various improved material properties without changing its basic characteristics. Tab.4 compares plasma technology and conventional finishing methods. Plasma can be used to achieve hydrophilicity and hydrophobicity, oil repellency, to reduce shrinkage caused by felting, increase dyability, increase fire resistance, increase UV protection, improve antimicrobial properties and adhesion, sterilization, improve antistatic properties, regulate gloss, etc. [37].

All the above examples of improvements in the finishing process contribute to the reduction of energy consumption. Energy costs are one of the main costs in the textile industry, so improving energy efficiency should be a priority for every textile plant. There are a number of opportunities to achieve energy efficiency improvements. However, even cost-effective options are often not implemented in textile plants due to limited information on how to implement energy efficiency measures, but also due to the fact that most textile plants are categorized as small and medium enterprises [39]. The introduction of novel highly efficient textile process-

Tab.3 Types of enzymes for different textile finishing processes

Enzymes	Application	Literature
Amylase, α-amylase, cellulase, maltase, lipase	Starch removal	[32-34]
Pectinase, cellulase, protease, lipase, xylanase	Scouring	[32-35]
Hidrolaze, pektinaze	Mercerisation	[32]
Cellulase, catalase, glucose oxydase, peroxydase, lacase, arilesterase	Bleaching	[32-35]
Lacase, lipase, protease, amylase	Dyeing	[32]
Cellulase	Softening of cotton	[32,33]
Cellulase, endoglucanase	Jeans treatments	[32-35]
Lipase, protease, hexokynase, cellulase, pectinase, xyanase	Polishing	[32,34]
Lignin peroxydase, lacase, manganese peroxydase	Dyestuff removal	[32,33]
Lignin peroxydase, lacaee, manganese peroxydase, tyrosinase	Wastewater bioremedia-tion	[32,35]

Tab.4 Comparison of plasma technology and conventional textile finishing treatments [38]

Parameter	Plasma treatment	Conventional finishing treatment
Solvent	No solvent	Water
Energy	Electrical	Thermal
Processing depth	Thin surface layer of material ~10 nm)	Fibre
Water and energy consumption	Low	Fibre
Pollution	Very low	High

ing methods, such as the previously mentioned supercritical CO_2 dyeing and the introduction of plasma or microwave processing technology, contributes to the improvement of energy efficiency. Further examples is ultrasonic treatment in the processes of bleaching, mercerization, starching, etc. This method is very suitable because it reduces the bath temperature and treatment time, ie consumes less energy and wastewater is reduced by 20-30 % compared to conventional processes. The use of digital printing also reduces water and energy use.

Preliminary cationization of cotton, ie the use of alternative auxiliaries, reduces the negative charge of cotton fiber, which reduces energy consumption by 75 % and water use by 90 %, with an additional reduction in the use of auxiliaries and dyestuffs in the dyeing process. If ozone is used in the bleaching process, there is a significant reduction in energy consumption, as the process goes at room temperature, and the processing time is shorter than usual. In addition, CO_2 emissions are reduced by 50 % in this bleaching process [40, 41]. The use of microwave energy in the processes of textile drying, pre-treatments (scouring and bleaching) and dyeing can also contribute to reducing energy consumption. Microwave drying consumes 60-70 % less energy than conventional drying, due to localized and uniform heating and less energy loss. In addition, drying is faster than conventional ones and there is no direct air pollution [42].

In addition to the above mentioned examples of reducing pollution from industrial plants and care for the life cycle of products, it is necessary to conduct continuous education of all participants in the production chain.

4. Conclusion

The Earth is man's natural habitat and people should do everything in their power to preserve it. Conversely, humans pollute, cut down forests, hunt animals and lead their own planet, step by step, towards its destruction. The European Green Plan is theoretically well thought out, but it is only feasible if we all fully adhere to it. Certainly, more attention should be paid to preserving the environment than to accumulating enormous amounts of waste at various locations. Fare more attention should also be paid to conserving the diversity of animal species instead of mass hunting of marine and terrestrial animals, and encouraging the conservation of forests and green spaces instead of mass destruction due to industry needs. It is precisely because of the human factor that today water, air and soil are polluted and destroyed almost to the point of no return.

The textile industry is one of the major polluters and consumers of water in the world. The fact that 20-25 % of the total world production of chemicals is used for textile processing is an indicator of the great impact of the textile industry on the environment. It is extremely important to make efforts to reduce the negative impact as soon as possible. The most important thing is to reduce waste immediately at the source, recycle, compost, regenerate and only when maximum utilization is achieved, the remaining waste must be disposed of properly. The waste should be disposed of in the best and safest way for man and the environment. Less harmful compounds and chemicals should be introduced into production processes, and special attention should be paid to recovery and their reuse in processes. The application of environmentally friendly agents, efficient devices and processing procedures with reduced consumption of energy, water and other raw materials and the development of awareness and education about the importance of biodiversity and environmental protection must become our everyday life that will ensure the future of textile and all other industries. It is the European Green Plan that can play a significant role in this.

Defining the laws, measures and guidelines that each Member State must implement in industry makes it easier to reduce the pollution. By involving all member states and adhering to measures, Europe could become the first climate-neutral continent, and if non-European countries are included in the European Green Plan, positive changes can be made at the global level. Only a joint effort and directing all of humanity on the right path can return our planet to the state it was in before the massive pollution and unfavorable anthropogenic impact.

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