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Opinion

Fibres, Textiles and Clothing: What Future in a World of Increasing Environmental Awareness?

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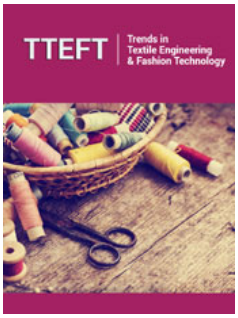

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Opinion

For thousands of years now textiles and clothing play a key role in the history of mankind. Without these two the world would be inhabitable. From desert circumstances to arctic conditions, fibres and textiles, garments are crucial for human existence. With a population of almost eight (8) billion people, fibres and textiles can continue to support human beings in ruling or running the world. But at what cost?

For hundreds or even thousands of years, natural fibres, i.e., vegetal or animal raw materials, have been the source for fibres, textiles and clothing. Fibres such as cotton (mainly), flax, animal fibres like wool and hair fibres, … were key for manufacturing clothes or protective materials (garments) to help people survive. This was valid till the end of the 19th century when regenerated materials, artificial fibres, such as viscose, after long research and testing started to be a competitor for fully natural fibrous materials. Viscose had many successors so far such as polynosic and modal fibres, lyocell, … but these (man-made) biobased fibres remain rather inferior in quantity, although not unimportant. With the research towards fully synthetic man-made fibres such as nylon (polyamide) and particularly polyester plus many similar fibres, a completely new era had started, initiated between World War I and II with a strong increase in importance since the 1950s. From the 1960s onwards polymer chemistry has been so successful that even more extraordinary fibres (specialty fibres) have been developed: aramid fibres (Kevlar, …), heterocyclic aromatic fibres such as polyimide fibres (P84, Yilun, polybenzimidazole fibres, PBO,…), carbon fibres, high performance polyethylene fibres (dyneema,…) and very interesting nanofibres because of miniaturization of manufacturing technology (components) seen from a mechanical point of view.

So, the role of chemistry (and particularly polymer chemistry) research and development generated a breakthrough in fibre technology and production. One word is crucial in all this: OIL, crude oil or petroleum: a fossil fuel material. What is the impact of this on our world of the 21st century, a century that can make or break mankind or mother earth?! We just have to think about the actual climate change and "sustainability", without any doubt "the" word of the years and decades to come, cf. environmental concern.

Actually, an amount of roughly 100 billion (100,000,000,000-) kg of fibres is being produced each year and this quantity is consumed by almost 8 billion people. Covid-19 may have had some influence on these figures but 100 billion is still a reasonable figure to work with. This means about 12kg fibres per capita per year!

The increasing world population or what we may also call "overpopulation", certainly will have its effect. The amount of 100 billion kg of fibres can roughly be split in 30 % of natural fibres (bio-fibres) and 70 % of man-made (semi synthetic plus synthetic) fibres. Synthetic

(plastic) fibres by far are outnumbering the natural and biobased man made (=semi synthetic) fibres such as viscose, acetate, etc! With more than 40 billion of kg of the synthetic fibre polyester, it is quite clear that during the last 50 and particularly the last 20 years in the new century the tone was and is set: petrol, oil is definitely the "golden calf", the holy grail in fibre production. Will this continue to be and if not, what is / are the alternative(s), taking into account that natural fibres such as cotton, wool, … will become even more under pressure (ecologically) in a world which tries to find a new equilibrium in its existence with a population which continues to grow and consuming raw materials faster and faster. Depleting our resources is risky and possibly can or will result in a catastrophic end.

Summarizing, till around 1900 without any doubt "cotton" was the fibre the world was relying on in order to fulfil our clothing needs. There were other fibres but by far less important. With about 1.5 billion people at that time (year 1900), the world could bear that burden. Currently however, with about 25 billion of kg/year, cotton is a huge and likely environmentally "dangerous" material for the production of fabrics, clothing and garments. It is known that enormous amounts of water are consumed to cultivate cotton fibres and frightening amounts of chemicals (biocides, fertilizers, …) are needed to come to a cotton textile cloth or garment. Can this go on, is this sustainable? Likely not! Similar questions do arise for other natural fibres, such as wool, cashmere, linen, etc. One possible answer is recycling but it is definitely not enough, not at all. One may wonder whether we can replace these fibres by new and innovative fibre technology? The way regenerated (so semi synthetic) fibres like viscose, modal, … are scrutinized to come to a better and less polluting production technology starting from the raw material, i.e., trees, pulp is worth to be supported even more. Research in that direction at least should be intensified. At the same time decarbonization is helped too.

In addition, however to the concern for cotton and other natural fibres, the main challenge remains to find a real alternative for oil, responsible for around 70 % of actual fibre production. In the next 25 to 50 years the use of oil for that purpose has to be decimated or even has to disappear completely. This is by far the most remarkable challenge mankind is facing: getting rid of fossil addiction in order to make this world survive, give it a break or prevent it from becoming extinct. Consequently, and not only for textiles, a turning point has to be realized with a textile chain thereby facing several problems:

A. The world population is continuously increasing, even faster than before. More fibre needs are noticed, and this will continue to be so!

B. Human beings, all of them, are striving for a better life. This also includes the search for better (quality) clothing and garments. Everybody aims at or hopes for a (more) comfortable life.

C. Actual CO_2 emissions in the air are catastrophic. Anything, any technology which helps to reduce this, must be stimulated. So, also the use of and the choice for new appropriate fibres.

D. Overconsumption by about a few percent of the actual world population is a real threat. Too often, fashion is just there to consume faster, to make fast money and to generate more products of a lower quality. The result is that millions of tons of clothes/textiles do end at the waste belt (in Africa, Chili, …).

E. Still the fibre to fabric chain is consuming dangerous or toxic chemicals in order to come to some upgrading of the fibre and grey cloths. Alternative ways to finish textiles are needed. People have to realize that any textile material, garment, … is depleting or can distort the earth. We have to be very cautious and show deep respect for all textile products ever produced and not throw them away.

So, what has to be done more taking into account that 10 billion people on this planet are not that far away from now anymore? In addition to the existing production of fibres such as cotton, wool, … (with high carbon footprint?), etc., we definitely have to look for a more environmentally friendly creation of textile fibres, from the beginning. A remarkable effort has to be realized in the area of biobased (natural) fibres such as viscose, modal, etc. These particular fibres in any case do need a new approach as far as production is concerned, with less polluting chemistry taking into account that the raw materials on which they are mainly based (wood pulp from trees,) are available in large amounts. Research may indeed help to make progress fast and contribute to the decarbonization of our industry.

The key task however is the replacement of oil as the source for our synthetic (plastic) fibres in the next decades. Fossil raw materials have to be left behind or must be outphased. Manufacturing of polyester fibre for example, a convenient class of fibre, cannot go on for a long time anymore using oil derivatives. This "number one" fibre must find another origin, so via molecules or monomers from all but oil origin! Oil will have to be banned or at least turned into a minor source of supply for textile fibres. This will demand intensive and vast edge breaking technological research based on joint forces, worldwide. Pandemic Covid-19 has shown this joint research is possible once it is really needed!

Although not straight for itself, the production of fibres via biotechnology (fermentation, bioreactors, enzymes,…) must be considered a real option and a valuable modern fibre production alternative. Biotechnology and biochemistry are (likely) the way to go!

Without any doubt the strong intention of recycling, circularity and manufacturing more (tailored) quality goods and garments are essential parts of the whole picture, the key and path which will lead to less waste and throwing materials away. Smart use of resources, a fashion industry with a focus on creating beauty leaving behind

actual fast fashion targets (i.e., making money and prioritizing short cycles), a better and optimal design, etc. A long list of challenges and targets need to be taken into account resulting in a new 21st century (textile) industry. That way will lead to a world which really pays credit to the word "sustainability", including optimal decarbonization, and refers to a true concern for the environment in which oil with its catastrophic impact once consumed, has no place or hardly a place anymore!

One can also refer to the actual revolution in the car industry which is leaving (or has to leave) behind the internal combustion engine, to a "green" alternative, i.e., electric vehicles or the use of hydrogen. The fibre and textile industry must behave similarly as far as the use of oil or petrochemical products are concerned!

Summarizing, fibre and textile manufacturing is still too much based on a consumption of "traditional" resources, generating significant amounts of waste resulting in severe damage to the environment. Air emissions (nitrous oxides, hydrocarbons, volatile organic components,…), water consumption and water pollution (by salts, surfactants, biocides,…) and solid waste pollution also have to be addressed in order to improve the sector's public image. This is the way forward and without any doubt it can be achieved. We all have to work towards a global approach and solution turning the future into a new era of hope, brighter than ever for fibres, textiles and clothing. By doing so, textiles and clothing will remain one of history's impressive economic engines. A herculean task without precedent in the history of textiles is waiting but there is no alternative!