_zine
https://zine.tcbl.eu
Circular, Vol. 3, Issue 1

Biological exhaust air purification in textile finishing

by Besnik Mehmeti

Flame lamination is a highly economical and widespread process in the textile industry for the production of textile composites consisting of e.g. textile webs, artificial leather or foils with a foam layer in between. Main application fields for these structures are upholstery materials for the automobile industry (e.g. for car seats, door panels, roof liners), medical technology sector, furniture industry or insulation materials. The foam webs (primary made of polyurethane) are treated with an open flame coming from a gas burner and afterwards connected to the other layers. The resulting thin, sticky layer of the foam is used for bonding with a wide range of materials. The laminates provide a simultaneously achieved cushion effect. The advantages of the flame lamination are that no solvents or glues are needed and hence no outgassing of the materials will take place during their usage, the process is technically easy to control and allows very high production speeds compared to other technologies, e.g. hotmelt process.

During the flaming of the foams, exhaust gases are formed, which need to be removed by suctioning. The composition of the exhaust gases is extremely diverse. Nitriles, ethers, diisocyanates, aldehydes, halogenated hydrocarbons (CFCs), amines, chlorinated phosphoric acid esters and benzene and 1,2-dichloroethane can be present. However, special attention is given to the highly toxic hydrogen cyanide (HCN, blue acid) which is released during the processing of polyurethane foams. This makes a treatment of the exhaust air necessary. Released cyanides are highly toxic, soluble in water and classified as highly water-endangering substances. Toxicity is based on the blockade of tissue

respiration in living beings by inhibition of enzymes. In order to protect nature and the environment, to safeguard viable working, residential and recreational areas, minimizing or avoiding such harmful biocidal emissions is required.

Currently various methods are known for cleaning exhaust air containing cyanide:

- Thermal treatment
- Oxidation in the low temperature plasma
- Catalytic detoxification using Cu-doped activated carbon
- Absorption of HCN in the basic medium (for example, in sodium hydroxide solution) and subsequent chemical detoxification via oxidation (with hypochlorite or hydrogen peroxide)
- Biological elimination

According to STFI´s own research, technical solutions for exhaust air purification have so far been installed at four of Germany's approximately 13 production sites with flame lamination. Thereof 2 are based on the biological process, one is performed chemically and one with the low temperature plasma technology. The high requirements for a technical exhaust air purification process are regarded as essential reasons for the low implementation of exhaust air cleaning measures for flame lamination.

STFI has developed a biological exhaust air purification process for treating cyanide-containing emissions from the process of flame lamination as a cost-effective and resource-saving alternative to chemical / physical methods. The establishment of a biological exhaust air purification process in the textile industry as an energy-efficient cleaning technology represents an innovation.

The advantages of the biological elimination method compared to the other processes are:

- No use of hazardous substances such as acids, alkalis, oxidation or reducing agents
- Exhaust air purification is performed at ambient temperatures; additional power supply is only needed for sprinkling and, if necessary, frost protection heating à sustainable and energy efficient process
- Real (biological) degradation of the problematic emission of hydrogen cyanide (no transformation into other problematic substances or transfer of the problem into waste water)
- Plant engineering is robust against dusts and accompanying emissions; dusts are separated by the waste gas scrubbing and can be disposed together with the resulting excess biomass
- Potential degradation of (previously) unknown non-target substances possible
- Low maintenance (1-2 plant maintenance per year at 24/7 operation)

The results obtained by STFI provide a scientific step towards the development of textile technology, machine and application technology as well as biotechnology and process engineering.