

Engineering of Cellulosic Cigarette Paper to Reduce the Toxic Emissions of Smoking

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The prevalence of smoking around the world is well known. During the smoking of cigarettes, various toxins in both the mainstream smoke and sidestream smoke are huge threats to people's health. In this context, the reduction of toxic emissions is indeed a global concern. Engineering of cigarette-related components, including cigarette paper and tobacco, is important for mitigating the negative impacts of smoking. In the case of cigarette paper, such concepts as decreasing the amount of cellulosic fibers, use of burn-promoting additives, increasing the permeability of paper, and use of catalysts, adsorbents, and/or reductants, have been proposed in the literature. The commercialization of technologies for the engineering of cellulosic paper is expected to result in the production of "healthier" cigarettes. A possible blueprint is to tailor cigarette paper to help smokers to completely quit smoking.

Keywords: Cigarette paper; Toxic emissions; Tobacco; Smoking; Smoking quitting

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Smoking and Its Toxic Emissions

Human beings have a very long history of smoking tobacco. The presence of nicotine in tobacco products is the key reason why many people are addicted to smoking. People may get pleasure, enjoyment, and relaxation from smoking. Smoking may also help people to ease their social communications/activities. However, a well-known fact is that smoking has a significant negative effect on the health of smokers, as well as many non-smokers (as a result of passive smoking by inhaling secondhand smoke). This is because during smoking, various toxins, including at least 70 known carcinogens (cancer-causing chemicals) and many others, are released. In this regard, it may be a little bit funny but really rather logical to say that when smoking, the smokers are initiating a dangerous chemical processing "plant" around them. In this "plant", over 4000 chemicals are produced. Many of these chemicals are huge threats to public health. In general, the top six toxins in tobacco smoke are: tar, nicotine, carbon monoxide, formaldehyde, hydrogen cyanide, and benzene. People exposed to the toxic emissions may develop lung diseases, fertility problems (in the case of women), *etc.* Therefore, smoking cessation and minimization of the negative impacts of smoking are global concerns.

Role of Cigarette Paper in Reducing Toxic Emissions of Smoking

Cigarettes are now the main type of tobacco products smoked by people around the globe. For the production of cigarettes, cigarette paper (*i.e.*, paper typically produced using flax or wood fibers, calcium carbonate, and burn rate modifiers as raw materials) is used. Cigarette paper is important in terms of tobacco wrapping/constructing for instance;

it also helps to control the characteristics of cigarettes, including such aspects as the burn rate of cigarettes, the number of puffs per cigarette, and the appearance of the ash. On the other hand, cigarette paper may affect the toxic emissions of smoking in the sidestream smoke during a puff and/or in the mainstream smoke during static burning of cigarettes; of course, such factors as the type of tobacco and the density of the tobacco column are of crucial importance. There have been a number of publications on engineering of cellulosic cigarette paper in order to decrease the toxic emissions, and the following are some of the concepts:

- Decreasing the amount of cellulose fibers per cigarette may result in reduced toxic emissions. Once a lower amount of fibers is present in the paper, the formation of carbon monoxide would be discouraged. A decreased amount of fibers is very likely to deteriorate paper strength and paper opacity, which may be mitigated by using a lower amount of filler (or a combination of fillers) with balanced optical properties.
- The increased use of burn-promoting additives (*e.g.*, potassium and sodium citrates) may reduce the number of puffs, and thus reduce the toxic emissions.
- Increasing the permeability of cigarette paper may decrease the amount of tobacco consumed during a puff due to air dilution, and thus reduce the toxic emissions.
- Engineering of cellulosic cigarette paper by adding catalysts, adsorbents, and/or oxidants may decrease the toxic constituents (mainly carbon monoxide) in the smoke. This effect can be based on catalytic, adsorptive, and/or oxidative functions of the additives.

In addition to the above-listed concepts, other possible ones may also be proposed, provided that the mechanism fits and they really work. It must be stated that the relationship between the structure/composition of cigarette paper and the toxic emissions is rather complex. A better understanding may be needed so that new technologies can be developed, and hence the research is now strongly going on in this area. For the above concepts (particularly the last one), one thing that needs to be claimed is that very large numbers of publications (particularly patents) are available in the literature; however, most of these are not able to be listed in the “Suggested References” section due to the length limit.

Possibilities

It is evident that smoking is rather disadvantageous to the public health. However, for cultural and other reasons, smoking prevalence throughout the world has always been a well-known fact. It goes without saying that the best way of avoiding the toxic emissions of smoking is to quit smoking permanently. In this sense, there is a great need for research on the science and technology on smoking cessation. However, in the near future this may not be completely targeted, so the development of cigarettes with decreased toxic emissions is important to mitigate the negative impacts of smoking. The engineering of cellulosic cigarette paper is conceivably one of the feasible ways of tailoring cigarettes to less significant negative environmental/health impacts. In principle, this can be implemented via various chemical, mechanical, and/or biological processes, for instance, by modifying the furnish components and the cellulosic network, adding functional chemicals/materials (either in wet-end or by surface application), *etc.* A possibility is that new paper products aimed at “healthier” cigarettes will be more and

more prevalent. It may also be possible to tailor the characteristics of cigarette paper to ease the process of quitting. Further, new and “healthy” concepts of smoking may be developed based on the cigarette paper.

However, nothing is that easy. There are possible challenges related to product costs, smokers’ habits, need of the tobacco industry to survive, *etc.* Despite all of these, the commercialization of technologies on engineering of cigarette paper would be of great significance. Globally, many institutions are currently working in this area. For instance, Mudanjiang Hengfeng Paper Co., Ltd (China) is now collaborating with Northeast Forestry University (China) aiming at developing new cigarette paper products tailored for decreased negative impacts related to smoking.

A possible blueprint is that the engineering of cigarette paper together with the engineering of other cigarette-related materials (essentially tobacco) will decrease the negative impacts of smoking and eventually help people to completely quit smoking.

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