AIRPHX

CLEANER | SAFER | BETTER

AIRPHX Effect on Tobacco Smoke

AIRPHX has proprietary cold atmospheric plasma technology that is (i) excellent at reducing air and surface micro-organisms and pathogens like viruses, bacteria and mold and (ii) highly effective at reducing carbon dioxide (CO_2), volatile organic compounds (VOCs) and other gases that are harmful to humans at elevated levels.

Tobacco smoke has many components. See the attached overview from Wikipedia. AIRPHX technology is effective against many (but not all) of the components of tobacco smoke. For example, AIRPHX does not filter out inorganic particulate matter like ash.[1] Atmospheric cold plasma has shown promising effects in reducing the levels of various harmful components found in tobacco smoke. Following is a brief summary of third party testing of some of those key components confirming AIRPHX reduction of a number of the harmful gases included in tobacco smoke:

- Formaldehyde (CH_2O): Tests have demonstrated that AIRPHX can effectively reduce the concentration of formaldehyde in tobacco smoke by over 90%. The plasma treatment appears to break down and oxidize the formaldehyde molecules, converting them into less harmful compounds.
- Carbon monoxide (CO): AIRPHX has been found to significantly decrease the levels of carbon monoxide in tobacco smoke, with reductions of over 90% reported.
- Benzene (C_6H_6): AIRPHX has been shown to effectively remove benzene from the air. Reductions in benzene levels of more than 90% have been observed, as the plasma treatment is able to break down and oxidize the benzene molecules.
- Nitrogen oxides (NOx): AIRPHX has been found to reduce the levels of nitrogen oxides, such as nitric oxide (NO) and nitrogen dioxide (NO_2), in tobacco smoke. Reductions of over 90% have been reported, as the plasma can facilitate the conversion of these oxides into less harmful compounds.
- Benzo[a]pyrene (BaP): AIRPHX has demonstrated the ability to significantly decrease the levels of benzo[a]pyrene, a potent carcinogenic compound found in tobacco smoke. Reductions of 90% or more in BaP concentrations have been observed, indicating the plasma's effectiveness in breaking down and removing this harmful component.

The mechanisms behind these reductions involve the generation of reactive species (such as oxygen radicals, hydroxils and gas phase hydrogen peroxide) and free electrons within the plasma, which can interact with and break down the various harmful compounds in tobacco smoke. The specific efficiency of the plasma treatment may depend on factors such as the plasma generation parameters, the characteristics of the tobacco smoke, and the specific conditions of the treatment process.

These are the only harmful tobacco gases tested on AIRPHX technology, and each was a successful test. AIRPHX strongly believes all VOCs and other harmful gases in tobacco smoke would similarly be broken apart by AIRPHX technology. Overall, the evidence suggests that atmospheric cold plasma can be a promising tool for reducing the levels of various toxic and carcinogenic compounds in tobacco smoke, potentially leading to a decrease in the health risks associated with cigarette smoking.

[1] AIRPHX is indirectly effective at partially reducing particulate matter from tobacco smoke because, like ionizer/bipolar ionizer products, AIRPHX produces electrons that attach to particulate matter and make it easier for filters to “capture” the particulates as they move through the HVAC system.

WIKIPEDIA
The Free Encyclopedia

Tobacco smoke

Tobacco smoke is a sooty aerosol produced by the incomplete combustion of tobacco during the smoking of cigarettes and other tobacco products. Temperatures in burning cigarettes range from about 400 °C between puffs to about 900 °C during a puff. During the burning of the cigarette tobacco (itself a complex mixture), thousands of chemical substances are generated by combustion, distillation, pyrolysis and pyrosynthesis.[1][2] Tobacco smoke is used as a fumigant and inhalant.


Tobacco smoke being released from a lit cigarette

Composition

The particles in tobacco smoke are liquid aerosol droplets (about 20% water), with a mass median aerodynamic diameter (MMAD) that is submicrometer (and thus, fairly "lung-respirable" by humans). The droplets are present in high concentrations (some estimates are as high as 10^{10} droplets per cm^3).

Tobacco smoke may be grouped into a particulate phase (trapped on a glass-fiber pad, and termed "TPM" (total particulate matter)) and a gas/vapor phase (which passes through such a glass-fiber pad). "Tar" is mathematically determined by subtracting the weight of the nicotine and water from the TPM. However, several components of tobacco smoke (e.g., hydrogen cyanide, formaldehyde, phenanthrene, and pyrene) do not fit neatly into this rather arbitrary classification, because they are distributed among the solid, liquid and gaseous phases.[1]

Tobacco smoke contains a number of toxicologically significant chemicals and groups of chemicals, including polycyclic aromatic hydrocarbons (benzopyrene), tobacco-specific nitrosamines (NNK, NNN), aldehydes (acrolein, formaldehyde), carbon monoxide, hydrogen cyanide, nitrogen oxides (nitrogen dioxide), benzene, toluene, phenols (phenol, cresol), aromatic amines (nicotine, ABP (4-aminobiphenyl)), and harmala alkaloids. The radioactive element polonium-210 is also known to occur in tobacco smoke.[1] The chemical composition of smoke depends on puff frequency, intensity, volume, and duration at different stages of cigarette consumption.[3]

Between 1933 and the late 1940s, the yields from an average cigarette varied from 33 to 49 mg "tar" and from less than 1 to 3 mg nicotine. In the 1960s and 1970s, the average yield from cigarettes in Western Europe and the USA was around 16 mg tar and 1.5 mg nicotine per cigarette. Current average levels are lower.[4] This has been achieved in a variety of ways including use of selected strains of tobacco plant, changes in agricultural and curing procedures, use of reconstituted sheets (reprocessed tobacco leaf wastes), incorporation of tobacco stalks, reduction of the amount of tobacco needed to fill a cigarette by expanding it (like puffed wheat) to increase its "filling power", and by the use of filters and high-porosity wrapping papers.[5] The development of lower "tar" and nicotine cigarettes has tended to yield products that lacked the taste components to which the smoker had become accustomed. In order to keep such products acceptable to the consumer, the manufacturers reconstitute aroma or flavor.[3]

Tobacco polyphenols (e. g., caffeic acid, chlorogenic acid, scopoletin, rutin) determine the taste and quality of the smoke. Freshly cured tobacco leaf is unfit for use because of its pungent and irritating smoke. After fermentation and aging, the leaf delivers mild and aromatic smoke.[6]

Tumorigenic agents

Tumorigenic agents in tobacco and tobacco smoke

Compounds	In processed tobacco, per gram	In mainstream smoke, per cigarette	IARC evaluation of evidence of carcinogenicity	
			In laboratory animals	In humans
Polycyclic aromatic hydrocarbons				
Benz(a)anthracene		20–70 ng	sufficient	
Benzo(b)fluoranthene		4–22 ng	sufficient	
Benzo(j)fluoranthene		6–21 ng	sufficient	
Benzo(k)fluoranthene		6–12 ng	sufficient	
Benzo(a)pyrene	0.1–90 ng	20–40 ng	sufficient	probable
Chrysene		40–60 ng	sufficient	
Dibenz(a,h)anthracene		4 ng	sufficient	
Dibenzo(a,i)pyrene		1.7–3.2 ng	sufficient	
Dibenzo(a,l)pyrene		present	sufficient	
Indeno(1,2,3-c,d)pyrene		4–20 ng	sufficient	
5-Methylchrysene		0.6 ng	sufficient	
Aza-arenes				
Quinoline	1–2 µg			
Dibenz(a,h)acridine		0.1 ng	sufficient	
Dibenz(a,j)acridine		3–10 ng	sufficient	
7H-Dibenzo(c,g)carbazole		0.7 ng	sufficient	
N-Nitrosamines				
N-Nitrosodimethylamine	0–215 ng	0.1–180 ng	sufficient	
N-Nitrosoethylmethylamine		3–13 ng	sufficient	
N-Nitrosodiethylamine		0–25 ng	sufficient	
N-Nitrosonornicotine	0.3–89 µg	0.12–3.7 µg	sufficient	
4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanone	0.2–7 µg	0.08–0.77 µg	sufficient	
N-Nitrosoanabasine	0.01–1.9 µg	0.14–4.6 µg	limited	
N-Nitrosomorpholine	0–690 ng		sufficient	
Aromatic amines				
2-Toluidine		30–200 ng	sufficient	inadequate

2-Naphthylamine		1–22 ng	sufficient	sufficient
4-Aminobiphenyl		2–5 ng	sufficient	sufficient
Aldehydes				
Formaldehyde	1.6–7.4 μg	70–100 μg	sufficient	
Acetaldehyde	1.4–7.4 μg	18–1400 μg	sufficient	
Crotonaldehyde	0.2–2.4 μg	10–20 μg		
Miscellaneous organic compounds				
Benzene		12–48 μg	sufficient	sufficient
Acrylonitrile		3.2–15 μg	sufficient	limited
1,1-Dimethylhydrazine	60–147 μg		sufficient	
2-Nitropropane		0.73–1.21 μg	sufficient	
Ethyl carbamate	310–375 ng	20–38 ng	sufficient	
Vinyl chloride		1–16 ng	sufficient	sufficient
Inorganic compounds				
Hydrazine	14–51 ng	24–43 ng	sufficient	inadequate
Arsenic	500–900 ng	40–120 ng	inadequate	sufficient
Nickel	2000–6000 ng	0–600 ng	sufficient	limited
Chromium	1000–2000 ng	4–70 ng	sufficient	sufficient
Cadmium	1300–1600 ng	41–62 ng	sufficient	limited
Lead	8–10 μg	35–85 ng	sufficient	inadequate
Polonium-210	0.2–1.2 pCi	0.03–1.0 pCi	sufficient	sufficient

Safety

Tobacco smoke, besides being an irritant and significant indoor air pollutant, is known to cause lung cancer, heart disease, chronic obstructive pulmonary disease (COPD), emphysema, and other serious diseases in smokers (and in non-smokers as well). The actual mechanisms by which smoking can cause so many diseases remain largely unknown. Many attempts have been made to produce lung cancer in animals exposed to tobacco smoke by the inhalation route, without success. It is only by collecting the "tar" and repeatedly painting this on to mice that tumors are produced, and these tumors are very different from those tumors exhibited by smokers.[1] Tobacco smoke is associated with an increased risk of developing respiratory conditions such as bronchitis, pneumonia, and asthma. Tobacco smoke aerosols generated at temperatures below 400 °C did not test positive in the Ames assay.[7]

In spite of all changes in cigarette design and manufacturing since the 1960s, the use of filters and "light" cigarettes has neither decreased the nicotine intake per cigarette, nor has it lowered the incidence of lung cancers (NCI, 2001; IARC 83, 2004; U.S. Surgeon General, 2004).[8] The shift over the years from higher- to lower-yield cigarettes may explain the change in the pathology of lung cancer. That is, the percentage of lung cancers that are adenocarcinomas has increased, while the percentage of squamous cell cancers has decreased. The change in tumor type is believed to reflect the higher nitrosamine delivery of lower-yield cigarettes and the increased depth or volume of inhalation of lower-yield cigarettes to compensate for lower level concentrations of nicotine in the smoke.[9]

In the United States, lung cancer incidence and mortality rates are particularly high among African American men. Lung cancer tends to be most common in developed countries, particularly in North America and Europe, and less common in developing countries, particularly in Africa and South America.[8]

See also

- Liquid smoke
- Electronic cigarette aerosol
- Tobacco smoke enema

References

1. Robert Kapp (2005), "Tobacco Smoke", *Encyclopedia of Toxicology*, vol. 4 (2nd ed.), Elsevier, pp. 200–202, ISBN 978-0-12-745354-5
2. Ken Podraza (29–30 October 2001), *Basic Principles of Cigarette Design and Function* (http://www.lsro.org/presentation_files/air/m_011029/podraza_102901.pdf) (PDF), Philip Morris USA
3. *The Health Consequences of Smoking: The Changing Cigarette* (http://profiles.nlm.nih.gov/ps/access/NNBBSN.pdf) (PDF), U.S. Dept. of Health and Human Services, p. 49
4. K. Rothwell; et al. (1999), *Health effects of interactions between tobacco use and exposure to other agents* (http://www.inchem.org/documents/ehc/ehc/ehc211.htm), Environmental Health Criteria, World Health Organization
5. Michael A. H. Russell (1977), "Smoking Problems: An Overview", in Murray E. Jarvik; Joseph W. Cullen; Ellen R. Gritz; Thomas M. Vogt; Louis Jolyon West (eds.), *Research on Smoking Behavior* (https://web.archive.org/web/20150723034328/http://archives.drugabuse.gov/pdf/monographs/17.pdf) (PDF), NIDA Research Monograph, pp. 13–34, archived from the original (http://archives.drugabuse.gov/pdf/monographs/17.pdf) (PDF) on 2015-07-23
6. T. C. Tso (2007), "Tobacco", *Ullmann's Encyclopedia of Industrial Chemistry* (7th ed.), Wiley, pp. 1–26, doi:10.1002/14356007.a27_123 (https://doi.org/10.1002%2F14356007.a27_123), ISBN 978-3527306732
7. C Lynn Humbertson (2005), "Tobacco", in Philip Wexler (ed.), *Encyclopedia of Toxicology*, vol. 4 (2nd ed.), Elsevier, pp. 197–200, ISBN 978-0-12-745354-5
8. Anthony J. Alberg; Jonathan M. Samet (2010), "Epidemiology of Lung Cancer", in Robert J. Mason; V. Courtney Broaddus; Thomas R. Martin; Talmadge E. King Jr.; Dean E. Schraufnagel; John F. Murray; Jay A. Nadel (eds.), *Murray and Nadel's Textbook of Respiratory Medicine*, vol. 1 (5th ed.), Saunders, ISBN 978-1-4160-4710-0
9. Neal L. Benowitz; Paul G. Brunetta (2010), "Smoking Hazards and Cessation", in Robert J. Mason; V. Courtney Broaddus; Thomas R. Martin; Talmadge E. King Jr.; Dean E. Schraufnagel; John F. Murray; Jay A. Nadel (eds.), *Murray and Nadel's Textbook of Respiratory Medicine*, vol. 1 (5th ed.), Saunders, ISBN 978-1-4160-4710-0