Proposal for a
DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
on the reduction of the impact of certain plastic products on the environment
(COM (2018) 340 final)

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Tobacco Product Filters

Filters are an important part of the design of a cigarette; they filter and reduce the number of toxicants inhaled by consumers and help ensure cigarettes do not exceed regulated levels of tar, nicotine and carbon monoxide.

"Smoke particles are removed by three filtration mechanisms, these being diffusion of the particles to the fibres, direct interception of particles by fibres, and inertial impaction of particles onto the fibres.

Diffusional capture of particles by fibres, depends on the Brownian motion of the very small smoke particles and is considered to be the most important filtration mechanism, particularly for the smaller particles which have the most erratic paths.

Direct interception depends on the particle being so situated in the stream flow through the filter that it will contact the fibre surface and thus be captured. Because of the mechanics involved, the capture of larger particles is favoured by this mechanism.

Inertia impaction is where the mass of the moving particle resists a change in direction as the stream turns to flow around a fibre. The particle tends to continue on its former course and thus strikes the fibre and is captured. This mechanism also favours the capture of the larger particles"[1]

A tobacco filter primarily contains three components: Cellulose Acetate, a hardening agent and adhesives.

- Cellulose Acetate fibres (filaments) compose a tow band from which a tobacco product filter is formed. Cellulose Acetate fibres are about 20 microns in diameter and a tow band can contain between approximately 15,000 to 55,000 individual filaments.
- As a hardening agent, triacetin (glycerol triacetate) is used to bond the tightly packed fibres together.
- Adhesives are then used to fix the bonded fibres to a wrapping paper (plug wrap) and also to "close" the Plug wrap along the length of the filter.

[1] Physical Mechanisms of Smoke Filtration (C. H. Keith) http://legacy.library.ucsf.edu/tid/hxe05c00/pdf

Cellulose Acetate: material sourcing, conversion & manufacture

Cellulose Acetate remains the most widely used material for making cigarette filters and has remained largely unchanged since its invention in the 1950's.

We work with sustainable suppliers (low CO footprint and water usage) to source renewable wood to produce wood pulp, the raw material for Cellulose Acetate. "Pure" Cellulose is obtained from wood pulp by the removal of Lignin and Hemi-Cellulose. Cellulose can be obtained from different natural sources (plant types) which have different cellulose content but ultimately once extracted it is all cellulose.

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Table 5.1 Chemical Composition of Some Common Fibers (% of total)

Type of Fiber	Cellulose	Lignin	Pentosan	Ash	Silica
Stalk fiber					
Rice	28–48	12–16	23–28	15–20	9–14
Wheat	29–51	16–21	26–32	4.5–9	3–7
Barley	31–45	14–15	24–29	5–7	3–6
Oat	31–48	15–19	27–38	6–8	4–6.5
Rye	33–50	16–19	27–30	2–6	0.5–4
Cane fiber					
Sugasse	32–48	19–24	27–32	1.5–5	0.7–3.5
Bamboo	26–43	21–31	15–26	1.7–5	0.7
Grass fiber					
Esparto	33–38	17–19	27–32	6–8	—
Sabai	—	22	24	6	—
Reed fiber					
Phragmites communis	44–46	22–24	20	3	2
Bast fiber					
Seed flax	43–47	21–23	24–26	5	—
Kenaf	44–57	15–19	22–23	2–5	—
Jute	45–63	21–26	18–21	0.5–2	—
Hemp	57–77	9–13	14–17	0.8	—
Ramie	87–91	—	5–8	—	—
Core fiber					
Kenaf	37–49	15–21	18–24	2–4	—
Jute	41–48	21–24	18–22	0.8	—
Leaf fiber					
Abaca (Manila)	56–63	7–9	15–17	3	—
Sisal (agave)	47–62	7–9	21–24	0.6–1	—
Seed hull fiber					
Cotton	85–90	0.7–1.6	1–3	0.8–2	—
Wood fiber					
Coniferous	40–45	26–34	7–14	<1	—
Deciduous	38–49	23–30	19–26	<1	—

Table 1: Chemical Composition of Some Common Fibres (% total)

Cellulose Acetate is produced by the reaction of cellulose with acetic anhydride and acetic acid (acetylation) that is then partially hydrolysed and finally dissolved in acetone to produces a viscous "dope". The "dope" is then spun to form the fibres with the desired cross-section.

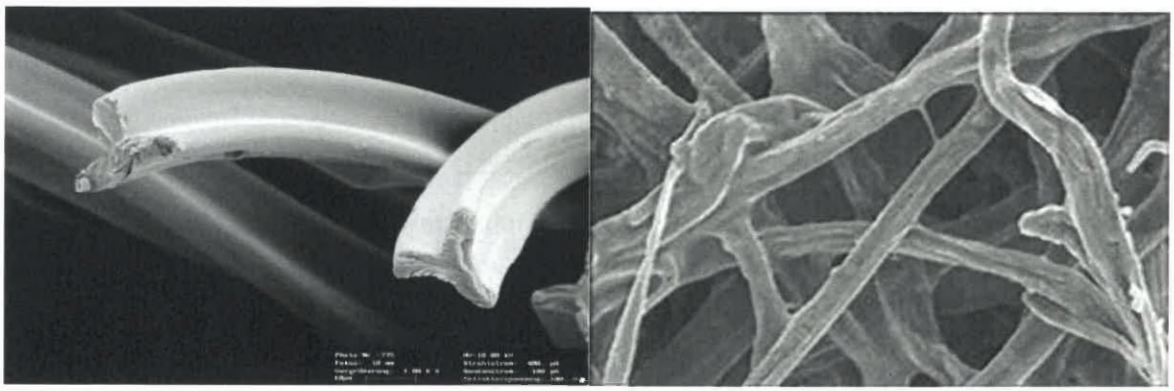

Image 1: Enhanced image of Cellulose Acetate fibres and Cellulose fibres

Tobacco Smoke

Tobacco smoke is an ever changing and extremely complex mixture of chemicals, many of which arise from several routes. The components are distributed between the gas phase and particles which constitute the smoke aerosol.

With the aerosol particles making up a mass concentration of around 4-5%, cigarette smoke is a very high particle concentration aerosol.

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Phase	Fraction	TPD Emission regulation	FCTC [10], TobReg +9 & HC [25]
Vapour	Permanent gases	CO	NO/NOx, HCN, Ammonia
	Organic volatiles		Acetaldehyde, Acrolein, Benzene, 1,3-Butadiene, Formaldehyde, Cadmium, Acrylonitrile, Crotonaldehyde, MEK, Acetone, Butyraldehyde, Propionaldehyde, Isoprene, Toluene
	Semi-volatiles		Phenol, o-cresol, Pyridine, Styrene, m-cresol, p-cresol
Particulate	Non-volatiles	"Tar", Nicotine	NNN. NNK, Benzo[a]pyrene, Formaldehyde, Cadmium, Hydroquinone, Catechol, 4-aminobiphenol, 2-aminonaphthalene, 1-aminonapthalene, 3-aminobiphenol, Resorcinol, Arsenic, Lead, Chromium, Mercury, Nickel, Selenium, NAB, NAT, Eugenol, Quinolene

Table 2: Phases of mainstream cigarette smoke and distribution of key classes of substance.

** Note some chemicals, e.g. formaldehyde and cadmium partitioned between the vapour and the particulate phases*

Current emission limits, established under the Tobacco Product Directive ("TPD"), focus on setting a maximum delivery of 10:1:10 mg of Tar, Nicotine and Carbon Monoxide, respectively.

NFDPM (Nicotine Free Dry Particle Matter) defines the Tar component of the particulate phase for regulatory purposes but does not directly define any other toxicological parameter. Some of these other constituents, particularly Organic Volatiles and Semi-volatiles, like Phenols (phenol, o-cresol, m+p-cresol, catechol, hydroquinone & resorcinol) are of toxicological significance.

In order to comply with the 10:1:10 maximum emission levels set by the TPD, the use of a non-plastic filter would require a complete redevelopment of the product which means the legislation is going far beyond the regulation of the single-use plastic product itself. Furthermore, manufacturers are not free to redevelop their products and must comply with strict rules concerning ingredients imposed by the TPD but also at Member State level. Regulation of the composition of the filter has the resultant effect of regulating the tobacco product and removing the key means by which tobacco companies comply with the TPD.

Work thus far

For decades, the industry has conducted extensive research into alternative materials to Cellulose Acetate and BAT has commissioned more than 20 different projects exploring the potential development of such alternatives.

A large criterion set, which includes, amongst others, sustainability, availability, scalability, performance, consumer perception and financials, has been considered in the evaluation of any alternative filtration material. However, ensuring that priority toxicant emissions in mainstream smoke do not increase has meant that Cellulose Acetate has remained the primary filter material. Thus far, the intrinsic filtration characteristics and efficiency of Cellulose Acetate have not been matched.

Filtration Efficiency

Different filtering materials have different physical and chemical characteristics, resulting in varying degrees of filtration efficiencies and affinities to different compounds.

Based on results of decades of research and development, tobacco products with non-Cellulose Acetate filter materials have always been hindered by the reduced filtration efficiency of these materials to certain compounds.

In general, paper filters, from wood or from other plant types, have an inherent lower filtration efficiency/affinity to Organic Semi-Volatiles like phenols, which results in an increased presence of these compounds in the mainstream smoke.

Type of Material (by groups)	Filtration efficiency: Vapour, Semi-Volatiles & Particulate (vs benchmark when normalized to Tar)
Cellulose Acetate	Benchmark
Alternative CA's	Comparable
CA + Paper Mixes	Potentially Comparable
Paper – Wood pulp	Increase in Volatiles & Semi-Volatiles
Cellulose – Wood Pulp	Increase in Volatiles & Semi-Volatiles
Paper – other plant sources	Increase in Volatiles & Semi-Volatiles
Others [PLA, PVOH, PP]	Varying results

Table 3: Filtration Efficiency reference

Tables 4 & 5 show some of the differences in filtration efficiency between Cellulose Acetate and other filtration materials. (*These tables contain confidential commercial information*).

Smoke yields normalised to tar	Code	CF13/01151	RF/00243	RF/00247
Ph				Paper
Particula				
Vapour				
Particula				
Vapour/				
Vapour				
Vapour				
Vapour				
Vapour				
Particulat				
Particulate				13
Ratios of vapour phase yields/tar yields, higher for vapour phase toxicants for paper filters				

Table 4: Comparison of Cellulose Acetate vs CA + Paper vs Paper – Wood

	Control	GB03_2014
Tar(mg)	13.6 (±0.8)	12.1 (0.6)

Table 5: Comparison of Cellulose Acetate vs Paper – other sources

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Summary

- The filter in a tobacco product is designed and manufactured to remove compounds from the smoke and depending on the material used, its filtration efficiency can vary greatly.
- A new non-Cellulose Acetate material will lead to an increase in a number of smoke compounds, particularly Organic Volatiles & Semi-volatiles like Phenols (when normalized to Tar/NFDPM).
- A new non-Cellulose Acetate material would represent a significant modification to the tobacco product and would therefore go beyond the regulation of the single-use plastic product itself.
- A new non-Cellulose Acetate material, due to the changes it would generate in the overall product, could trigger unforeseeable and unknown changes in consumption behaviours.

Conclusion

Whilst **there is currently no feasible alternative to Cellulose Acetate for filters, we are committed to finding a solution.** We continue to seek to reduce the impact of our products on the environment by investing and innovating to test and develop alternative materials, both internally and with third party suppliers. However, **it is imperative that we do this without compromising the level of emissions to which consumers are exposed.**