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## EUROPEAN QUALIFYING EXAMINATION 2024

# Paper B

This paper comprises:

Inhalt (11 Seiten „Beschreibung der Anmeldung“ und „Ansprüche“) nur auf dem Bildschirm während der Prüfung verfügbar

Content (11 pages „Description of the application“ and „Claims“) only available on screen during the examination

Contentu (11 pages „Description de la demande“ et „Revendications“) uniquement visible sue l‘écran pendant l‘examen

**Drawings of the application**

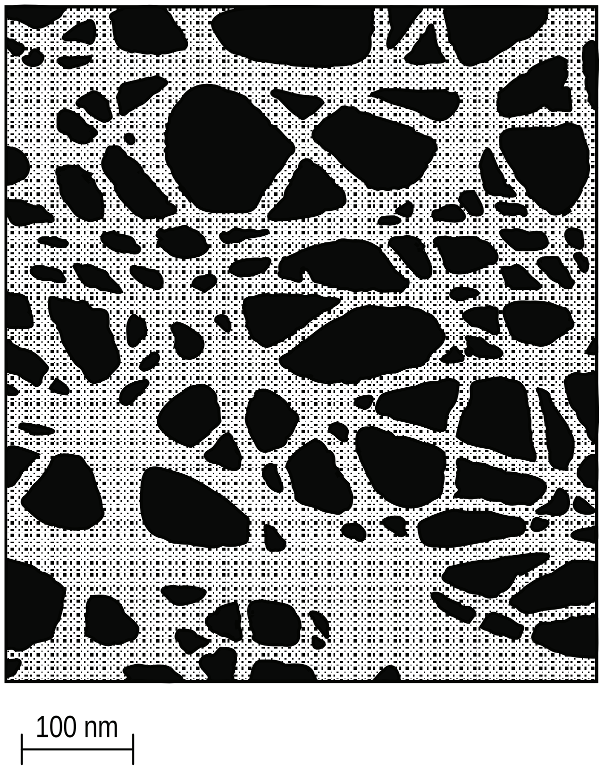


FIG. 1

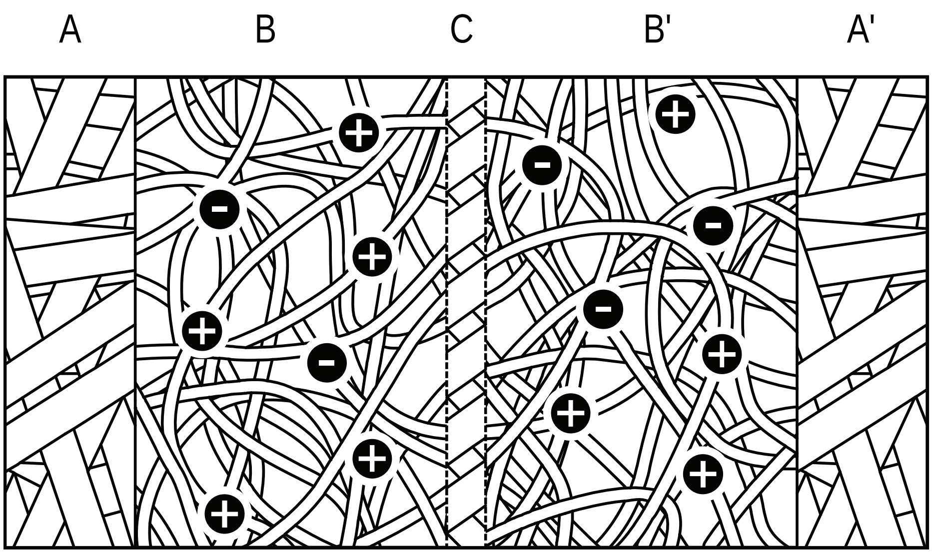


FIG. 2

## Document D1: Ecological face masks for protecting against COVID-19

*French company in Provence launches a new, fully biodegradable face mask based on natural hemp fibres.*

[001] Cellulose fibres from cultivated plants like cotton, flax, hemp, etc., have good mechanical strength, hydrophilicity, and biocompatibility, can resist pathogens effectively, and can neutralise viruses.

[002] This makes them suitable for use in antifungal, antibacterial and antiviral filters.

[003] Face masks made of cellulose fibres from cotton, flax or hemp could thus be a potential substitute for face masks made from synthetic polymers.

[004] Face masks made from synthetic polymers can cause respiratory harm to a healthy wearer due to low breathability.

[005] It has been reported that cotton double-layer cloth can be about 75% as efficient as a surgical face mask for capturing small aerosols, while having much better breathability.

[006] The antiviral efficiency can be further enhanced by impregnation of the cotton cloth with an antiviral chemical substance bearing electrostatic charges, for example polyethyleneimine (PEI), by a process of adsorption by soaking.

[007] The enhanced ability to trap the virus is attributed to the electrostatic interaction between the positively charged PEI and the negatively charged virus surface.

[008] The impregnated cotton fabric is thus antiviral, and can be used to manufacture antiviral face masks.

[009] Building on this idea, cotton double-layer cloth face masks have been developed which are made of super-soft 100% organic cotton in a tightly knitted fabric.

[010] Hemp is another source of cellulose fibres having a large surface area for trapping microparticles and microbes.

[011] A 100% organic hemp face mask can protect the nose and mouth from inhaling aerosols with a 98% filtration efficacy guarantee for particles of 3 µm or above, while providing excellent air permeability and breathability.

[012] These biodegradable hemp face masks are composed of a single layer (thickness 2 mm) of 100% organic filtering felt made of compacted cellulose fibres from hemp without chemical treatment.

[013] In order to increase cohesion of the compacted cellulose fibres from hemp, a glue of natural origin such as gelatin or collagen is used as the only non-toxic, biodegradable additive.

[014] These face masks are ecological, biodegradable and washable, and they can be either disposed of or reused after disinfection in boiling water for 30 seconds.

[015] When disposed of, the face masks are completely compostable within three months.

[016] In addition to cultivated plants, agricultural waste rich in cellulose fibres can also be used as the starting material.

**D1: Photo**

**<u>Document D2: EP 6 001 001</u>**

Title: Reusable antiviral nanofilters based on cellulose acetate nanofibres

[001] Trilayer nanofilter systems are provided comprising a middle layer of a synthetic polymer, which is cellulose acetate, with a smooth ultrafine nanofibre structure.

[002] A solution of cellulose acetate at 2% by weight in trifluoroethanol (TFE) (caution: toxic solvent!) was prepared. Once dissolved, a nonwoven nanofibre layer (nanofilter) was manufactured by electrospinning.

[003] Electrospinning is a complex technique in which high voltage is applied to a polymer solution to form a fine filamentous structure. For this, an emitter voltage of 18kV and a collector voltage of -8kV were used, with a flow rate of 20 mL/h, through a linear multi-emitter injector.

[004] The cellulose acetate nanofibre layer was deposited on a rotating collector at a speed of 200 rpm at a distance of 20 cm. The rotating collector was covered with a biodegradable, 40 µm-thick, nonwoven, cotton spunbond fabric forming the first outer layer of the trilayer nanofilter system. The deposited cellulose acetate nanofibre layer (middle layer) had a thickness of about 8 µm. Then, another 40 µm thick nonwoven cotton spunbond fabric layer forming the second outer layer of the trilayer nanofilter system was placed over the cellulose acetate nanofibre layer to produce the final trilayer structure. Four-layer or five-layer nanofilter systems can also be produced using this process.

[005] The cellulose acetate nanofibre layer generated by electrospinning was studied by scanning electron microscopy (SEM). The cellulose acetate nanofibres form a network with an average pore size of between 80 nm and 100 nm, which can be used as a nanofilter.

[006] FFP2 respiratory face masks are manufactured using the nanofilter system described above.

[007] The FFP2 respiratory face masks are advantageous in that they can be washed and reused several times, thus reducing waste and plastic pollution.

**<u>Document D3: The Encyclopedia of Polymers – Cellulose acetate</u>**

[001] Cellulose acetate is one of the first synthetic fibres to have been derived from cellulose. It was first prepared by French chemist Paul Schützenberger in 1865 by chemical treatment of cellulose with acetic anhydride using organic solvents such as methylene chloride.

[002] Cellulose acetate fibres are used as a film base in photography and in the manufacture of cigarette filters.

Disposal and biodegradation:

[003] While it was initially believed that cellulose acetate was virtually non-biodegradable, it has been shown that the cellulose backbone can be broken down by enzymes present in the soil. In biologically highly active soils, cellulose acetate fibres can biodegrade after nine months.

[004] However, it is also well known that cigarette filters made of cellulose acetate fibres can take years to completely biodegrade in the open. This currently presents a significant environmental challenge worldwide.

Inhalt (7 Seiten „Bescheid“ und „Schreiben des Mandanten“ ) nur auf dem Bildschirm während der Prüfung verfügbar

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**<u>Document D4: Provided with client's letter</u>**

*Effects on lung function of wearing surgical and FFP2 face masks*

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*Balmy Breezes International Sanatorium, Davos-Platz*
*Journal of Inhaleability Vol. 1, page 12 (2021)*

<u>Background</u>

[001] Following the outbreak of the SARS-CoV-2 pandemic, use of face masks is widely recommended or even mandatory. Millions of persons are required to wear a face mask when they come into contact with other individuals for long periods of time. We have studied the effects of wearing disposable surgical and FFP2 face masks on lung function.

<u>Materials and methods</u>

[002] For the study, 12 healthy male volunteers (aged 32 to 44 years) were enrolled. Each subject performed three tests, one “no mask” (control), one with a surgical face mask, and one with an FFP2 mask. Lung function parameters were monitored according to known methods [1].

[003] We used typical and widely used disposable surgical face masks and FFP2 protective face masks comprising multiple layers of nonwoven synthetic polypropylene (PP) fibres available on the market (Kung-Fu Protection Technology Co. Ltd., China).

Results and discussion

[004] Table 1. Lung function parameters of health volunteers wearing a surgical mask or an FFP2 mask compared to no mask (control). Mean ± standard deviation. FVC (forced vital capacity), FEV1 (forced expiratory volume in 1 s), PEF (peak expiratory flow), VE (ventilation). Statistically significant differences compared to no mask (control) indicated by an *.

| | No mask | Surgical mask | FFP2 mask |
|---|---|---|---|
| FVC (litre) | 6.1 ± 1.0 | 5.6 ± 1.0 * | 5.3 ± 0.8 * |
| FEV1 (litre) | 4.3 ± 0.7 | 4.0 ± 0.7 * | 3.7 ± 0.6 * |
| PEF (litre/second) | 9.7 ± 1.6 | 8.7 ± 1.4 * | 7.5 ± 1.1 * |
| VE (litre/min) | 131 ± 28 | 114 ± 23 | 99 ± 19 * |
| Breathing frequency (breaths per min) | 15 ± 2 | 13 ± 3 | 12 ± 3 * |

[005] The use of face masks showed a marked effect on lung function.

[006] All lung function parameters were significantly lower with the use of a face mask as compared to wearing no face mask. The impairment was greater with the use of an FFP2 mask.

[007] The calculated ventilation rate (VE), which indicates the volume of air inhaled or exhaled from a person’s lungs per minute, was significantly reduced with both types of face mask, especially when wearing an FFP2 mask, which resulted in a reduction of ventilation by 23% as compared to no mask.

[008] The reduction in ventilation (VE) was associated with a lower breathing frequency with a corresponding reduction in inhaled air volume.

[009] All participants reported consistent and marked discomfort wearing face masks, especially FFP2 face masks which were perceived as very uncomfortable, creating a feeling of strong breathing resistance.

[010] We conclude that wearing a disposable face mask has a marked negative impact on lung function and breathing comfort, both at rest and during exercise, which significantly impairs strenuous physical and occupational activities.

References

[1] Fikenzer S. et al. Clin Res Cardiol 109, 1522-1530 (2020)

Inhalt (2 Seiten „Geänderte Ansprüche“) nur auf dem Bildschirm während der Prüfung verfügbar

Content (2 pages „Amended claims“) only available on screen during the examination

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