Rezero

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Reusable masks: protecting health and the environment

Recommendations for its acquisition, making and main tenance

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Content

1. The impact of masks

The Covid-19 pandemic will leave us with many images, some very painful and others full of hope and solidarity. But if there is an object that can serve as an identification of this period, it is the masks.

After the first months full of messages, often contradictory, about the convenience of their use, it seems that, finally, health authorities and most of the public administrations converge on a single message: masks are necessary and will be accompanying us for a long time. Catalonia, the Balearic Islands and other state territories have already decreed the mandatory use of masks, both in open spaces and in closed spaces open to the public.

The different epidemiological studies that have been carried out on the survival of the virus on various surfaces and the alerts from health authorities about the danger of spreading the virus linked to the misuse of certain individual protection elements, seem to have stopped the unnecessary consumption of plastic gloves in favor of correct and frequent hand washing.

Masks, however, will continue to be a product of necessary use in the long term and, in this sense, there are two aspects that must be paid attention to: the environmental impacts derived from the massive consumption of disposable masks and the need for information on the sanitary guarantees of reusable masks.

Terrassa Institute for Textile Research and Industrial Cooperation - INTEXTER- UPC has calculated that, if each Spaniard uses two disposable surgical masks per week, they would add up to 94 million masks, generating 220 tons of polypropylene per week. According to data provided by the international movement Break Free From Plastic, the consumption of a mask a day for a year would mean the generation of three billion masks per year globally.

To this generation of unrecyclable plastic waste, we must add the danger of spreading the virus when masks are not thrown away in the right garbage container and the impacts that they can cause on natural and aquatic ecosystems.

Likewise, we found that, currently, citizens who opt for reusable masks do not have enough information about the requirements these masks must meet or the certifications required to ensure that they are truly protective. In fact, the supply of reusable masks is clearly on the rise, but often without any information regarding their degree of filtration or breathability, key factors to guarantee the effectiveness of masks. The European Committee for Standardization is working to harmonize all the different certifications in order to provide this information.

From Rezero we want to help clarify what types of masks exist, in what way they protect, for whom their use is recommended according to the type and, especially, provide concrete information on the use of reusable masks, their cleaning and maintenance or what technical aspects to consider when making homemade masks.

We would like thank Professor Enric Carrera, director of INTEXTER -UPC, for his contributions

and for the reviews of this document.

We hope this report is useful for people who want to continue contributing to move towards a zero waste society.

2. Types of masks

There are three types of masks:

- **PPE** or self-filtering masks (FFP1, FFP2 and FFP3) that protect from the inside out (prevent us from emitting viruses to the outside of the mask) and from the outside in (the mask prevents viruses from entering our respiratory system).

  These are especially suitable for healthcare professionals who are directly exposed to the Covid-19 virus.

  The main property is that they are able to filter particles equal to or larger than 0.3 microns. However, this filtering capacity varies depending on the model. FFP1 filters 78% of particles of this size. FFP2 filters 92% and finally FFP3 filters 98%. These models may or may not have an exhalation valve. Those that have a valve are completely inadequate for the current needs of the pandemic because they do not filter the air coming out and therefore can contaminate. FFP2 and FFP3 also protect against aerosols, which are the microdroplets that we project when we cough, sneeze, scream or sing, within which the Covid-19 virus can travel.

- **Surgical ones** are made of non-woven polypropylene polymers. They protect from the inside out, but only partially from the outside in.

  They are initially intended for healthcare professionals working in an operating room to prevent the patient from being exposed to any virus or bacteria that can be breathed by operating room staff. They have a water-repellent exterior finish that prevents any splashes of fluids produced during the operation from affecting medical personnel. They are recommended for healthcare personnel, confirmed Covid-19 patients, and suspicious carriers. They filter particles larger than 3 microns in size and have a bacterial protection efficiency that ranges between 95 and 98% depending on the model and a breathability between 40 and 60 Pa / cm2. Microbial cleaning should be equal to or less than 30 cfu / g. In principle, they are disposable and it is recommended to use them for no more than 4 hours in a row.

- As a result of the health crisis of Covid-19, a new category of masks has been created, called **Hygienic** or cloth mask. These include non-reusable (polypropylene non-woven)

and reusable (woven or elastic fabric). These only filter from the inside out, meaning that they are what are called solidarity masks (such as surgical masks). The reusable ones must meet a requirements of bacterial filtration efficiency greater than 90% and breathability less than 60%. This can be achieved with different combinations of fabrics, fibers, etc.

Therefore, except for medical personnel, infected people or those belonging to a risk group (pregnant women, the chronically ill, etc.), hygienic masks should be worn. According to the WHO, the most recommended masks for non-medical people are fabric masks, but they must meet certain conditions.

In any case, and according to the Ministry of Consumer Affairs (Spain), in order to protect ourselves, both hygienic and surgical masks must be accompanied by other safety measures such as hand washing and safety distance.

3. Reusable masks

There are three types of reusable hygienic masks:

1) Those that meet the **UNE 0065** specifications of reusable hygienic masks for adults and children in terms of materials, design, manufacture, markets and uses. These must:

- Be made of materials with:

  Bacterial filtration efficiency (BFE) equal to or greater than 90%

  Breathability less than 60 Pa/cm2

- May consist of one or more layers (of a single material or combination of materials). In the case of combinations of different materials, the filter layer should be placed in the middle. If the combination is double-layer, the filter layer should be placed as an outer layer.

- Be washable at least five times with any of the methods outlined in the Mask Care section of this document.

- They can withstand at least 5 cycles of washing and drying while maintaining their benefits.

2) Those that follow **specifications of other standards**, as long as they meet the

following acceptance criteria (evaluated according to the tests of the UNE-EN 14683 standard):

- A bacterial filtration efficiency (BFE) equal to or greater than 90%
- Lower breathability than 60 Pa/cm2

3) Those that **have no references to rules or essays**. These cannot guarantee an adequate level of protection.

Materials

The Spanish Ministry of Industry, Trade and Tourism has published a list of materials for reusable hygienic masks (single-layer materials or combinations of multi-layer materials) from different manufacturers. It is a list of a purely indicative nature that has been drawn up from the information received by the companies and is updated and published on the website https://www.mincotur.gob.es/es-es/COVID-19/Paginas/guias-para-fabricacion-de-mascarillas-y-ropa- de-proteccion.aspx.

Although masks made with any of the UNE0065 certified fabrics are already appropriate, this standard also establishes a series of design and tailoring criteria that can be adopted in their production.

General tips for reusable masks

- Masks including a layer for disposable filters are not recommended as they require additional handling that could be hazardous.
- Opt for masks with ergonomic shapes such as the duck's beak to prevent air from entering the folds.
- For reasons of comfort and hygiene, it is usually recommended not to wear the mask for more than 4 hours.
- The masks are for personal use only and must not be shared.
- The mask must be changed if it gets wet or visibly dirty; a mask that has been moistened should not be worn for a long time.

- In case it deteriorates due to use, it is recommended to replace it with another one.

4. Homemade masks

For the home making of masks it is recommended to use UNE0065 certified fabrics. Another solution is to follow the recommendations proposed by the World Health Organization, although these do not specify the filtration and breathability of the tissues and combinations they pose.

When making masks, it is necessary to take into account:

- **Breathability**: it is the ability to allow breathing through the material. It depends on the fabric and is measured in millibars (mbar), pascals (Pa) and, if measured in an area of the mask, per square centimeter (mbar/cm2 or Pa/cm2).
- **Filtering efficiency**: this depends on how tight the fabric is and the fineness of the fibers or the diameter of the threads (and, in the case of non-woven materials, the manufacturing process). The finer the fibers, the more barrier effect the fabric has.

Depending on the type of fabric, filtration efficiency and breathability can complement or hinder each other. You need to choose materials that trap particles and droplets but allow you to breathe without difficulty.

WHO recommendations include that the ideal **combination of materials** are three layers placed as follows:

1) an inner layer of hydrophilic material [absorbent], for example, of cotton, alone or mixed.

2) a hydrophobic [repellent] intermediate layer of nonwoven synthetic material such as polypropylene or a layer of cotton that improves filtration or traps droplets.

3) an outer layer of hydrophobic material (eg polypropylene, polyester or mixtures of both) that limits the entry of external contamination through the nose and mouth.

WHO- World Health Organization- does not recommend cotton masks as it is a fiber hydrophilic and therefore can absorb droplets and aerosols that are projected when screaming, singing or sneezing that may have the Covid-19 virus.

The shape of the masks can be flat-folded or duck-billed (conical) and the edges should be closely attached to the nose, cheeks and chin.

Other tips for making masks

- Do not embroider masks – this will make little holes where the air can enter and therefore viruses too.
- It is not recommended to coat the fabric with compounds such as wax, as this coating can completely block the pores of the mask and make breathing difficult. In addition to lower breathability, unfiltered air is more likely to escape through the sides of the mask when exhaling.
- To make masks it is preferable not to use a very elastic material because it stretches over the face and this increases the size of the pores and reduces the filtration efficiency. In addition, elastic materials can degrade over time and do not withstand high temperature washing.
- Opt for materials that withstand high temperatures (60°C or more).

5. Maintenance of reusable masks

Some of the tips to keep in mind for the maintenance and correct use of reusable masks are:

- Remove the mask without touching the front. After doing so, do not touch your eyes or mouth.
- Store the mask in a sealed bag until it can be washed and cleaned.
- Wash your hands immediately after handling the mask.
- Wash hygienic masks frequently and handle them carefully so that they do not contaminate other items.
- Choose washable fabrics and check that they withstand high washing temperatures. The manufacturer will indicate the maximum number of washes. From here, the effectiveness of the mask/fabric is not guaranteed. Using a washing method other than the recommended one can damage the product and, therefore, make it lose its effectiveness.

- Do not try to clean the mask in the microwave. There is no conclusive data on the effectiveness of sanitation with this method.

Although it is recommended to manipulate the masks to a minimum, in some situations when we are away from home we take them off. In these cases, they should not be stored in your pocket or bag directly or on surfaces - such as tables - but in breathable containers such as cloth bags (which should be washed), paper bags or envelopes and always in the same position. Plastic bags are not recommended for this purpose as they retain moisture.

Washing methods will depend on the material used. However, the Spanish Ministry of Health has published the following 3 washing methods that can eliminate Covid-19:

1. Wash the masks with normal detergent and water at a temperature between 60º and 90º (normal washing machine cycle).

2. Immerse the masks in a 1:50 bleach dilution with warm water for 30 minutes. Then wash with soap and water and rinse well to remove any remaining bleach and allow to dry.

3. Any of the virucidal products authorized by the Spanish Ministry of Health for use by the general public and in accordance with the manufacturer's recommendations (paying special attention to the diluted or undiluted use of the product and the contact times necessary for the disinfectant activity). Once the masks have been disinfected, they should be washed with plenty of soap and water and then allow them to dry to remove any remaining chemicals.

According to the WHO, when hot water is not available, the mask can be washed with water at room temperature and soap or detergent, and then:

i) boiled for one minute, or

ii) soaked in chlorine solution at 0.1% for one minute and rinse thoroughly with water at room temperature to remove toxic chlorine residues.

Washing tips according to materials

- The non-woven material of polypropylene polymers can be washed at temperatures up to 125° C, but there is a risk that its compactness and, therefore, filtration capacity will be modified.
- Natural cellulosic fibers can withstand high temperature washing and ironing.
- If non-woven material is used, wash the mask gently (without rubbing, stretching or squeezing too much).
- The combination of non-woven material and cotton withstands high temperatures. Masks made from this combination can be boiled or treated with hot steam, but there is a risk that their compactness and therefore filtration capacity will change.

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