Proposal of mechanical recycling and feasible applications for disposable surgical masks.

TITLE:
Proposal of mechanical recycling and feasible applications for disposable surgical masks.

AUTHORS:
Cravero Fulvia, Bernagozzi Giulia, Battegazzore Daniele, Frache Alberto

ABSTRACT:
In a singular period, such as during a pandemic, the use of personal protective masks has become mandatory for all citizens in many countries worldwide. The most used devices are the disposable masks, that generate a substantial waste flow sent to incineration or landfill.
The characteristics of the constituent materials of the most common three-layered disposable masks have been studied through morphological, chemical, physical, and thermal analyses. Based on these investigations, mechanical recycling protocols with different approaches were proposed. The advantages and disadvantages of the different recycling solutions, along with the necessity of separation processes and other treatments have been analyzed.
The four solutions investigated lead to a recycling index from 78 to 91% of the starting disposable mask weight. The rheological, mechanical, and thermo-mechanical properties of the final materials obtained from the different recycling approaches were compared with each other and with solutions present on the market resulting in materials potentially industrially exploitable. In particular, the study then focused on the development of an FDM 3D printable material with the aim of giving an added value to the recycled masks.
Different percentages of talc were added to the pristine masks to confer specific rheological and thermal properties. However, this solution was not fully satisfactory, thus the masks were partially replaced by a first-use polypropylene copolymer. Two formulations with 35 and 50 wt.% of mask-material were selected as suitable for 3D printing applications.
In the further step, sanitized after use masks were used. The extruded pellets were processed to produce printing filament. Then, the mechanical properties and microstructure of the tensile specimens were characterized and compared with a commercial FDM material. For the first time was verified that a 3D printable material from disposable face masks can be obtained and shows comparable stiffness and strength to the commercial one.