

Maintenance of Indoor Air Quality By Polyacrylonitrile Air Filters (PAN)

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Abstract:- This paper describes the maintenance of indoor air quality by using the polyacrylonitrile filters (PAN). The PAN filters were placed in-between the jars to find out the air filtering capacity of these filters. The main objective of this is to develop high efficiency filters thereby reducing the environmental pollution. The polymers that have a strong attraction to main components of smog, particularly particles that are smaller than 2.5 microns, known as PM2.5. Current filtration systems that can remove them from the air are very energy intensive. It turned out that polyacrylonitrile (PAN), a material commonly used to make surgical gloves, met these requirements. Using a technique called electro spinning, liquid PAN was converted into a serious health threat to the public as well as influencing visibility, direct and indirect radiative forcing, climate, and ecosystem. Particulate matter is a complex mixture of extremely small particles and liquid droplets. These days people tend to spend more time indoors. According to a study people spend 90% of time indoors. Now-a-days staying indoors becomes unsafe due to poor indoor air quality

I. SOURCE OF INDOOR AIR POLLUTION

1. New carpet. Carpet materials can emit a variety of volatile organic compounds (VOCs).
2. Broken compact fluorescent lights.
3. New electronics and other [plastic](#) products.
4. Glues and adhesives.
5. Heating equipment (stoves, heaters, fireplaces, chimneys).
6. Paints and strippers
7. Upholstered furniture and pressed-wood products (hardwood plywood, wall paneling, particleboard, fiberboard).

II .NEED FOR AIR FILTERS

Indoor air pollution is the degradation of indoor air quality by harmful chemicals and other materials; it can be up to 10 times worse than outdoor air pollution. This is because contained areas enable potential pollutants to build up more than open spaces. Statistics suggest that in developing countries, health impacts of indoor air pollution far outweigh those of outdoor air pollution. Indoor air pollution from solid fuels accounted for 3.5 million deaths and 4.5% global daily-adjusted life year (DALY) in 2010; it also accounted for 16% particulate matter pollution

III. PAN FILTERS

The polymers that have a strong attraction to the main components of smog, particularly particulate matter that are smaller than 2.5 microns, known as PM2.5. Current filtration systems that can remove them from the air are very energy intensive. It turned out that polyacrylonitrile (PAN), a material commonly used to make surgical gloves, met these requirements.

IV .METHODOLOGY

Using a technique called electrospinning, liquid PAN was converted into web-like fibres that are just a thousandth the diameter of a human hair. The final material allows about 70% transparency and yet collects 99% of the particles. The fibres just keep accumulating particles, and can collect up to ten times its own weight. Liquid polyacrylonitrile is formed from polymerization of acrylonitrile. This is also called as PAN. There are two types of electrospinning: vertical electrospinning and horizontal electrospinning. The steel mesh of required size is kept in front of the either in a vertical and horizontal manner. The steel mesh acts as a support and adhering substrate for the fibre. The needle of the device starts spinning the liquid PAN to fibres over the steel wire mesh. (Using electrospinning device,

liquid PAN was converted into web like fibres). After it has completely formed a layer over the mesh, switch off the device. Now the polyacrylonitrile fiber filter is formed.

V. UNIQUE FEATURES OF PAN FILTERS

- The thickness of one PAN fibre strand is thousand times smaller than human hair
- And because of this reason the PAN filters are transparent and cost efficient
- The transparency increases as the distance between the fibre increases
- Due to the surface chemistry and strong adhesion property to PM between 2.5 and 10 micrometer the particles passing through it gets captured in the filters.
- The distance between the fibres allow the passage of air and light through it which is an additional benefit of this filter
- It also provides low resistance to air flow

VI. COST ESTIMATION

- Steel mesh wire 1 m x 1 m is around rupees 50 (depends on the thickness). But the steel mesh should be changed once in six months
 - Polyacrylonitrile fibre costs 120 rupees
 - Therefore 1 sq.m of mesh requires 100 g of PAN liquid
 - So for a filter it requires up to 60-70 rupees for the first week
 - Then on the consecutive week there is no need to change the steel mesh. Therefore it just costs rupees 12-15 (fibre cost) every week for 1 sq.m.
 - This is one of the cost efficient filters.
 - The fibre just keeps accumulating particles and can collect 10 times its own weight.
 - So on an average the filter should be changed once in a week

VII. CONCLUSIONS

Though evidence exists for increase in indoor air pollution in India, and its association with both increased morbidity and mortality, there is still a need of further studies to assess the exposure levels of indoor pollutants and to further strengthen the evidence for their association with outcomes like

tuberculosis, cataract, asthma, cardiovascular health, and cancers. At the same time, effective interventions, starting from education, change in fuel patterns, proper designing of stoves and houses, to a committed and determined intersectoral coordination towards promotion of public health is the need of the hour. Therefore PAN filters can serve as better alternatives.

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