

REVIEW of PhD Thesis

Title of the thesis **“Elimination of contraceptive hormones from wastewater by means of filtration”**

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Description of the thesis

The thesis deals with the preparation and properties evaluation of electrospun nanofibrous polymeric systems for the removal of estrogenic hormones from wastewater. The treated subject is greatly very interesting and very important, since it concerns the serious problem of the protection of the environment.

The plan of the thesis is classical with an abstract, a theoretical part, an experimental part, conclusions and contribution to science and practice. The main conventional and advanced methods for water treatment are presented and discussed in the theoretical background. The preparation of membranes by electrospinning process is presented and discussed as well as the main factors which influence the process, i.e the molecular weight of the polymer and its concentration in the solution, the intrinsic viscosity and electrical conductivity of the solution. External parameters such as the flow rate and type of needle which influence the electrospinning itself are also mentioned. Additionally, the useful use of nanoparticles with nanofibers to provide specific photoactive properties for hormone degradation and removal is highlighted. The risks of environmentally hazardous estrogenic hormones and the methods to eliminate them are discussed along with the electrospinning process for membranes preparation and samples characterization. The main instrumental methods used to characterize the prepared materials are described with the specific arguments for their use in the present work.

The experimental part includes the preparation of electrospun nanofibers with different functional groups and physical and chemical properties based on carefully selected hydrophilic and hydrophobic polymers. The adsorption activity of the successfully prepared nanofibers was evaluated with four estrogenic hormones : estrone, estradiol, estriol and ethinylestradiol (designated E1, E2, E3, EE2, respectively). The adsorption of estrogenic hormones was carried out in aqueous solution by using electrospun nanofibers from waste cigarette butts. However, elctrospun polyurethanes coated with polyaniline/polyvinyl alcohol have been used for the removal of ethinylestradiol hormone (EE2).

Adsorption kinetics and associated interaction mechanisms of hormones were investigated on prepared membranes.

The thesis has 208 pages (attached published papers not including), 73 figures (including schematic diagrams and reactions), 21 tables and 190 relevant references. The figures and diagrams are well presented and of very good quality. The cited literature is adequately chosen.

Comments and remarks

- ✓ Many sentences are incorrect or too long. Different words (or units) are used to define the same parameter (ex. “stress at breakage” vs “stress at break”, “MPa” ws “N/mm²”;
- ✓ The introduction is too short and does not present and discuss other related studies by other authors;

- ✓ Several objectives are presented for this thesis work instead of one main objective with several steps for the successful completion of the thesis;
- ✓ Conclusions are presented for each distinct stage of the work along with concluding remarks, conclusions of the work carried out in the form of summaries of published articles. However, it lacks a general conclusion for the whole thesis work

It should be pointed out that these comments and remarks in no way alter the quality and scientific level of the presented thesis, especially given the amount of work accomplished and the considerable number of articles published.

Questions

The following questions are addressed to the PhD candidate and for which answers are expected during the defence of the thesis:

- ✓ Which parameters were taken into account for the choice of hydrophobic and hydrophilic polymers to be used as membranes?;
- ✓ Based on contact angle measurements, what would be the boundary between hydrophobic and hydrophilic properties?
- ✓ It is proposed to extend the number of cycles to ten in order to determine the reusability of the material. Why just 10?. Would it be possible to determine the lifetime of the membranes in another way?;
- ✓ All four hormones were tested together in the present study. Would it be possible to first select the suitable polymers and then for more efficiency test the hormones separately?;
- ✓ For which reasons(s), only hormone ethinylestradiol (hormone designated EE2) was tested using polyurethane nanofibers coated with polyaniline/polyvinyl alcohol membrane?;
- ✓ Figure 6.3 (page 90): What is the parameter which defines the strength of a material, its breaking stress or maximum stress?. How was determined Young's modulus of PP and PET?.

The PhD candidate is first author in 5 papers and co-author of 3 additional papers which are published in scientific journals with impact factor, in addition to 5 papers in scientific international conferences. He carried out several experimental tests for the evaluation of the mechanical and the physical properties as well as analysed the structures and morphologies of prepared membranes.

The subject of the thesis is of a high scientific level and of particular importance for water treatment as well as environmental protection. The doctoral work may induce an important scientific advancement in the field of utilization of nanofibers and nanoparticles in the water treatment as well as in the science of nanotechnology.

The submitted thesis doctoral thesis fulfils all formal requirements imposed by PhD degree regulations at of the Tomas Bata University in Zlín.

Based on the above and on the impressive experimental work carried out and the more than satisfactory number of published articles, I recommend the defence of the thesis in front of the examination committee in order to obtain the PhD degree.

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