



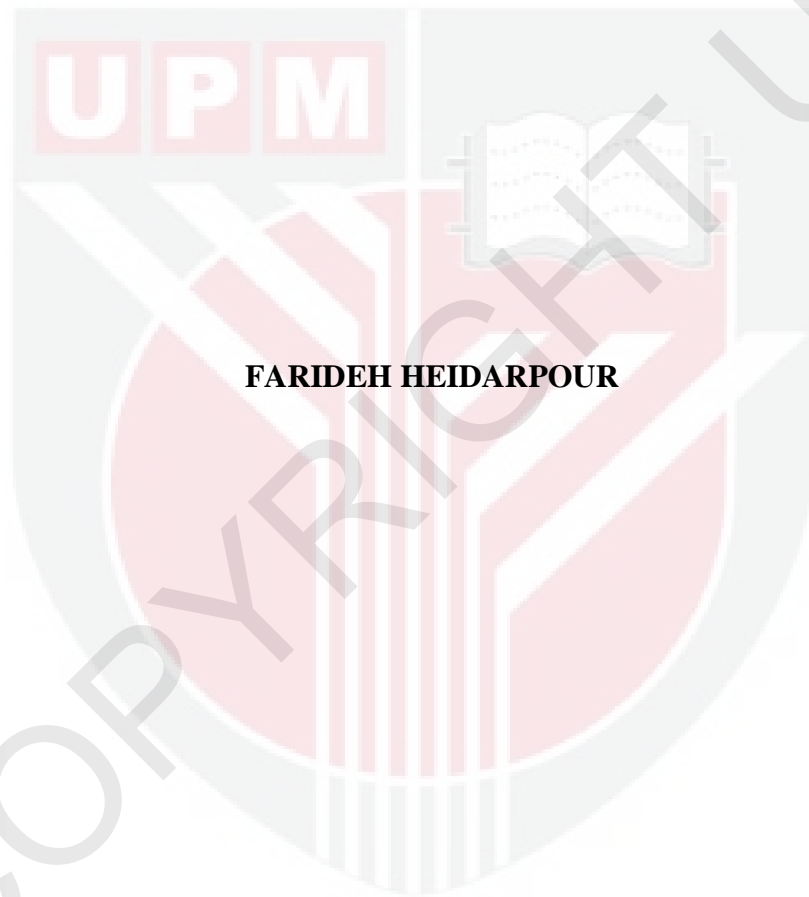
**UNIVERSITI PUTRA MALAYSIA**

***FABRICATION AND TESTING OF NANO SILVER-COATED  
FILTERS FOR WATER TREATMENT***

**FARIDEH HEIDARPOUR**

**FK 2010 68**

**FABRICATION AND TESTING OF NANO SILVER-COATED FILTERS FOR  
WATER TREATMENT**



**FARIDEH HEIDARPOUR**

**MASTER OF SCIENCE  
UNIVERSITI PUTRA MALAYSIA**

**November 2010**

## DEDICATIONS

*“To my lovely and supportive and ever encourage family”*

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

**FABRICATION AND TESTING OF NANO SILVER-COATED FILTERS FOR WATER TREATMENT**

By

**FARIDEH HEIDARPOUR**

**November 2010**

**Chairman : Wan Azlina bt. Wan Abdul Karim Ghani, PhD**

**Faculty : Engineering**

As adequate freshwater supplies decrease steadily, novel technologies are required for water purification. Nanotechnology, a new scientific frontier, promises to revolutionize innovation in many industries. Advancements in nanotechnology are being applied in the water-purification industry, to keep harmful bacteria out of drinking water. Nano silver is used in many products as an antibacterial function due to its bactericidal properties. This study aimed to produce and investigate the effect of a nano silver coated water filter using polypropylene filter (NSF) via the physical vapor deposition method. The production of nano silver filter is used the modified Balzers 760 machine which was equipped with an electron beam gun ESQ 110. The nano-silver particles were made by electron beam bombardment of the silver metal, which were subsequently deposited on

the polypropylene filter evenly. The thicknesses of the nano layer coated on the filters were about 35.0nm, 45.0nm and 55.0nm in average. Nano layer pore sizes, thicknesses, and crystallographic structure were determined by scanning electron microscopy (SEM), atomic force microscopy (AFM) and the X-ray diffraction technique (XRD) respectively. The water inoculated about  $10^3$ cfu/ml Escherichia coli. The inductively coupled plasma/mass spectrometry (ICP/MS) was used to determine amount of silver nano-particles in water sample after filtration. The results showed that the count of nano silver particles in the filtered water sample was nil. At a flow rate of 3L/hr and after 6hour filtration 100% bacteria were removed for 55nm nano silver coated filter (NSF) and more than 99% Escherichia coli were inactivated for 45nm, and 35nm NSF, when the input water had a bacterial load of  $10^3$  colony-forming units (CFU) per mL. SEM photos revealed the present of filtered bacteria on the nano silver filter (NSF) after passing through the polluted water. Furthermore, the percent of removed bacteria increases with increasing removal time but decreases with increasing water flow rate. The filter system produced in this work has the potential to be used as an efficient water treatment method.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PEMBUATAN DAN UJIAN PENAPIS AIR DILAPISI PERAK NANO UNTUK RAWATAN AIR**

Oleh

**FARIDEH HEIDARPOUR**

**November 2010**

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Selari dengan air tawar yang menurun secara menerus teknologi baru perlu bagi penulenan air. Teknologi nano sebuah sempadan sains baru, menjanjikan kita merevolusi inovasi di dalam banyak industri. Kemajuan dalam teknologi nano sedang diaplikasikan dalam industri penulenan air, untuk mencegah bacteria berbahaya daripada air minum. Nano perak digunakan di dalam pelbagai produk sebagai fungsi antibakteria kerana sifat bakterisidanya. Kajian ini bertujuan untuk menghasilkan dan mengkaji kesan perawatan air berasaskan nano perak menggunakan penapis polipropilena (NSF) melalui kaedah deposisi stim fizikal. Mesin Balzers 760 terubahsuai dilengkapi dengan beam electron senjata ESQ 110 digunakan untuk penghasilan NSF zarah nano perak yang kemudian diletakkan di atas penapis polipropilena dan diratakan. Ketebalan lapisan

nano melapisi penapis adalah masing-masing sekitar 35.0nm, 45.0nm, dan 55.0nm secara purata. Saiz poros lapisan nano, ketebalan dan struktur kristallografik ditentukan oleh pengimbasan mikroskop elektron (SEM), atom kekuatan mikroskopik (AFM), dan pembelauan sinar X-ray (XRD). Induktif plasma berpasangan/ spektrometer jisim (ICP/MS) digunakan untuk menentukan jumlah zarah nano perak di dalam sampel air selepas penapisan. Keputusan kajian mendapati bahawa hitungan nano zarah dalam sampel air ditapis adalah kosong. Pada kadar alir 3L/hr dan setelah penapisan selama 6 jam lebih daripada 99% E-coli dilemahkan pada beban  $10^3$  unit bakteria per mL. Bagi imej SEM menunjukkan bakteria ditapis 45nm and 35nm oleh NSF disaluti nano perak setelah dilalukan air tercemar di atasnya. Keputusan kajian menunjukkan bahawa dengan bertambahnya waktu, peratus bakteria yang dihapuskan juga turut meningkat akan tetapi semakin bertambahnya laju aliran air, menyebabkan jumlah bakteria yang dihapuskan semakin menurun. Hal ini adalah disebabkan oleh bakteria memerlukan lebih banyak masa untuk dihapuskan oleh zarah nano perak. Sistem penapis yang dihasilkan dalam kajian ini mempunyai potensi untuk digunakan sebagai kaedah air yang efisien dan biaya berhemat perawatan.

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**Sincerely**

**Farideh Heidarpour**



I certify that a Thesis Examination Committee has met on 12 November 2010 to conduct the final examination of Farideh Heidarpour on her thesis entitled "Fabrication and Testing of Nano Silver-Coated Filters for Water Treatment" in accordance with the Universities and University College Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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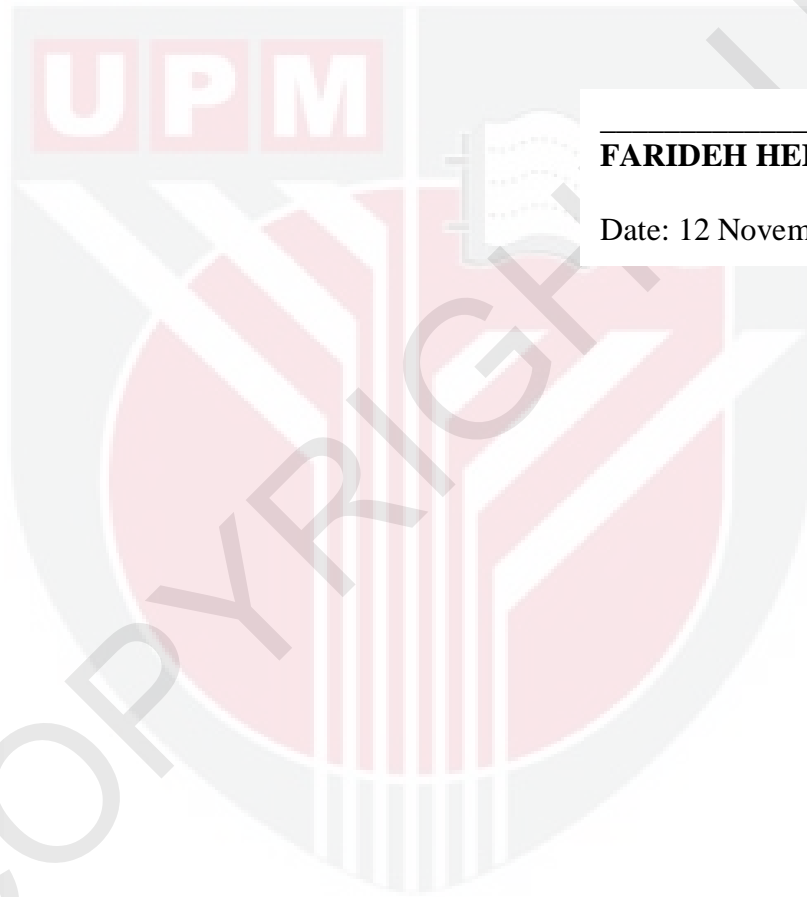
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## DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for other degree at Universiti Putra Malaysia or at any other institution.



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