



# **Developing New Catalytic Membrane Technology for Filtration**

A Thesis

Submitted to The Faculty of Engineering  
Ain Shames University for the Fulfillment  
of The Requirement of M.Sc. Degree  
in Civil Engineering

In Cooperation With:

Technische Universität München, Department of Chemistry  
and Catalysis Research Center

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## DEDICATION

*This thesis is dedicated to:*

***My Mother***

*For Her Continues Motivation and Energetic Support*

*And To:*

***All My lovely Family***

*Finally To:*

***My Friends***

***Specially For the Rowing Family***

*For Their Encouragement and Support*

## **STATEMENT**

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the degree of M.Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the department of Public Works, Faculty of Engineering, Ain Shams University, from ----- to -----.

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others

Date: - ---/--- /2018

Signature: - -----

Name: - Abdelrahman Khalaf Fekri

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## **ABSTRACT**

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**SPECIALTY:** Civil Department, Public Works Department, Sanitary & Environmental Engineering.

**IN COOPERATION WITH:** Technische Universität München, Department of Chemistry and Catalysis Research Center

### **ABSTRACT:**

The influence of macromolecular additives on the mechanical properties of polyethersulfone (PES) and polysulfone (PS) is investigated. Ultrafiltration membrane sheets are prepared from PES and PSF based polymers via liquid non-solvent induced phase separation (NIPS), and employing polyvinylpyrrolidone (PVP), polyethylene glycol (PEG) and Pluronic® (PLU) co-polymers as macromolecular additives.

The impact of additives on the main membranes’ characteristics are studied; i.e., pure water permeability, membrane porosity, morphology and surface chemistry. The main mechanical properties are examined for all membranes and are correlated to the chemical composition of the membranes. Overall, the membranes prepared using PLU showed a superior tensile strength compared to other membrane samples, while PVP was found to enhance the membrane formation by suppressing microvoids formation.

This study provides a better understanding of the main mechanical and other characteristics of membrane materials with regards to using these additives.

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**KEY WORDS:**

Ultrafiltration membrane; polyethersulfone; mechanical properties; tensile strength.

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▪ **CHAPTER (1)**  
**INTRODUCTION**

This chapter includes a brief description for membrane followed by summary for thesis chapters and main study points.

**1.1. Membrane Definition**

It is hard to define membranes exactly, but membranes could be described as selective barrier between two phases on the microscopic level where the term “selective” rooted to the membrane process. Many other variables could be used to describe the membrane, thin or thick, homogeneous or heterogeneous structure, active or passive transport, concentration or a temperature difference, charged or neutral [1].

Membranes raised up as a main element in chemical technology used in wide range of applications due to its ability to control permeated species as in controlling drug permeation rate to human body and separation of one component of a mixture [2].

25 years ago, membrane development as filtration tool in the separation process was not concerned seriously, despite in today’s world with two generations of membranes, membrane got a huge attention as effective separation equipment. The first generation of membranes included: microfiltration (MF), ultrafiltration (UF), hyperfiltration (HF) or reverse osmosis (RO), electrodialysis (ED) and dialysis. While the second membrane generation included gas separation (GS), pervaporation (PV), membrane distillation (MD) and separation by liquid membranes (LM) [1].

## 1.2. Study Objective

For the current study, characterization of ultrafiltration membranes in both physical and mechanical perspective is the main objective. In order to have competitive results, membranes fabricated in varies components and tested according to international standards and measurements.

## 1.3. Work Plan

In order to achieve study objective, membrane fabrication is an essential step using components picked carefully. Membrane fabrication started by preparation of samples list with components dosage then followed by the fabrication procedure.

Secondly comes the characterization stage with testing plan includes different kind of chemical, physical and mechanical characterization to check all membrane properties.

Finally results comparison is the last stage in order to have a clear vision on how membrane behavior relative to change in components and different conditions.

## 1.4. Thesis Organization

The Thesis consists of six chapters as follows:

### **CHAPTER 1: INTRODUCTION**

This chapter introduces general overview of current research objective and work plan.

### **CHAPTER 2: LITERATURE REVIEW**

This chapter includes basic knowledge for membrane science and main edges needed in further work.

### **CHAPTER 3: EXPERIMENTAL WORKS**