

**POLYETHERSULFONE-ZnO MIXED MATRIX  
HOLLOW FIBER MEMBRANE WITH ANTI-  
FOULING PROPERTIES FOR HUMIC ACID  
REMOVAL**

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HUMIC ACID REMOVAL**

**by**

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## LIST OF ABBREVIATIONS

AA	Acrylic acid
AC	Activated carbon
AFM	Atomic force microscopy
AG	Air gap
ANOVA	Analysis of variance
APTES	Aminopropyltriethoxysilane
ATRP	Free radical polymerization
BF	Bore fluid
BSA	Bovine serum albumin
BSMM	Hydrophobic surface modifying macro molecule
CA	Contact angle
CAP	Cellulose acetate phthalate
CCD	Central composite design
CNT	Carbon nanotube
CPES	Carboxylic polyethersulfone
CSMM	Charged surface modifying macro molecule
DBPs	Disinfection by products
DEG	Diethylene glycol
DIPS	Diffusion induced phase separation
DOE	Design of experiment
DPS	Dihydroxy diphenyl sulfone
DS	Dope speed
FA	Fulvic acid

FESEM	Field Emission Scanning Electron Microscopy
FRR	Flux recovery ratio
HA	Humic acid
HAF	Humic acid flux
HAR	Humic acid rejection
HEMA	2-hydroxyethylmethacrylate
HF	Hollow fiber
HNTs	Halloysite nanotubes
HS	Humic substances
LSMM	Hydrophilic surface modifying macro molecule
MBR	Membrane bioreactor
MM	Mixed matrix
MWCNT	Multiwall carbon nanotubes
MWCO	Molecular weight cutoff
NIPS	Non solvent induce phase separation
NOM	Natural organic matter
NPs	Nanoparticles
P(MMA-AA-VP)	Poly(methylmethacrylate–acrylic acid–vinyl pyrrolidone)
PAI	Poly amide-imide
PAN	Polyacrylonitrile
PEG	Polyethylene glycol
PEG-HPS	Poly (ethylene glycol)-hydroxy benzene sulfonate
PEG-MA	Poly(ether glycol) methyl ether methacrylate
PES	Polyethersulfone
PES-g-PDMAEMA	Polyethersulfone-poly(N,N-dimethylamino-2-ethyl methacrylate)

PES-g-PNIPAAm	Polyethersulfone- poly (N-isopropyl acrylamino)
PPOX	Polypropylene diol
PSf	Polysulfone
PSf-g-POEM	Polysulfone graft-poly (ethylene glycol) methyl ether methacrylate
PVDF	Polyvinylidene fluoride
PVDF-HFP	Polyvinylidene fluoride-co-hexafluoropropylene
PVP	Polyvinylpyrrolidone
PWF	Pure water flux
RAFT	Reversible addition- fragmentation chain transfer polymerization
RFR	Relative flux ratio
RSM	Response surface methodology
RW	River water
SMA	Styrene-maleic anhydride
SMM	Surface modifying macromolecules
SPAES	Sulfonated poly(arylene ether sulfone)
SPC	Soybean phosphatidylcholine
SPES	Sulfonated polyethersulfone
TEOS	Tetraethylorthosilicate
TiO <sub>2</sub>	Titanium oxide
TIPS	Thermally induce phase separation
TOC	Total organic carbon
UF	Ultrafiltration
ZnO	Zinc oxide