Virtual
IICC 2021 International Industrial Chemistry Conference
1st International Industrial Chemistry Conference
26-28th February 2021

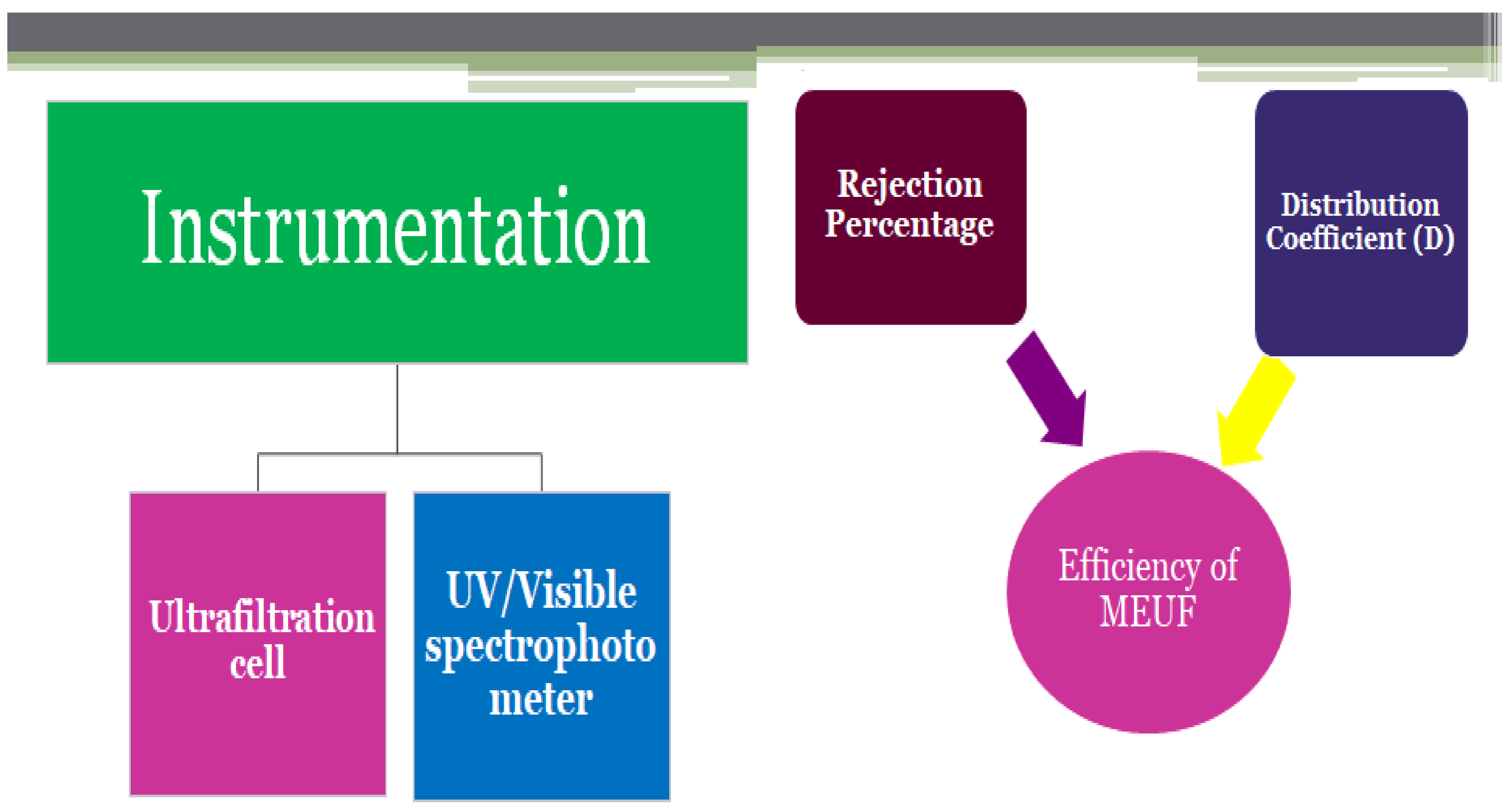
Micellar Enhanced Ultrafiltration for the removal of Rhodamine B from aqueous system

Amnah Yusaf, Muhammad Usman, Asim Mansha, Tanveer Hussain Bokhari, Matloob Ahmad, Muhammad Siddiq
Department of Chemistry, Government College University Faisalabad, Pakistan

Introduction

A large number of dyes are being used in industries i.e. textiles, paint, food and paper industry. Effluent of said industries causes water pollution and prevents penetration of sunlight into water bodies. Even very small amount (1 ppm) of some dyes in industrial waste should not be ignored due to its horrible effect on ecosystem and food chain. . Surfactants are the compounds having hydrophobic and hydrophilic parts in the same molecule. This structural attribute of surfactants enables them to play their part as detergents, emulsifiers, foaming agents, solubilizers, drug delivery agents, wetting agents, flotation agents; etc. in daily life and industry [2-4]. The amphiphilic structure of surfactants enable them to undergo micellization, the ability to form self-aggregates at/after a certain value of concentration called "Critical Micelle Concentration (CMC). MEUF, being energy efficient and cost effective, can be applied for simultaneous removal of organic, inorganic and charged species. High percentage recovery of surfactants has made MEUF to be a proficient alternative of reverse osmosis (RO) and nanofiltration (NF) [29]. Although its initial set up is expensive but set up cost is compensated by subsequent cost saving due to recycling of permeate [30].MEUF is an efficient process in terms of low pressure and energy requirements. The pressure range for MEUF to work efficiently is 97-587 kPa. The membranes used for micellar enhanced ultrafiltration are anisotropic in nature and range in pore size from 10-100 Å (1000 to 50,000 MWCO) The aim of the present work is to study the effects of various parameters, such as, concentration of surfactant, trans membrane pressure, Rotations per minute (RPM), concentration of electrolyte and pH to search an efficient dye removal method.

Experimental Procedures



Rejection Percentage

Removal efficiency of micellar media was calculated rejection coefficient.

$$R = \left(1 - \frac{C_p}{C_f}\right)100$$

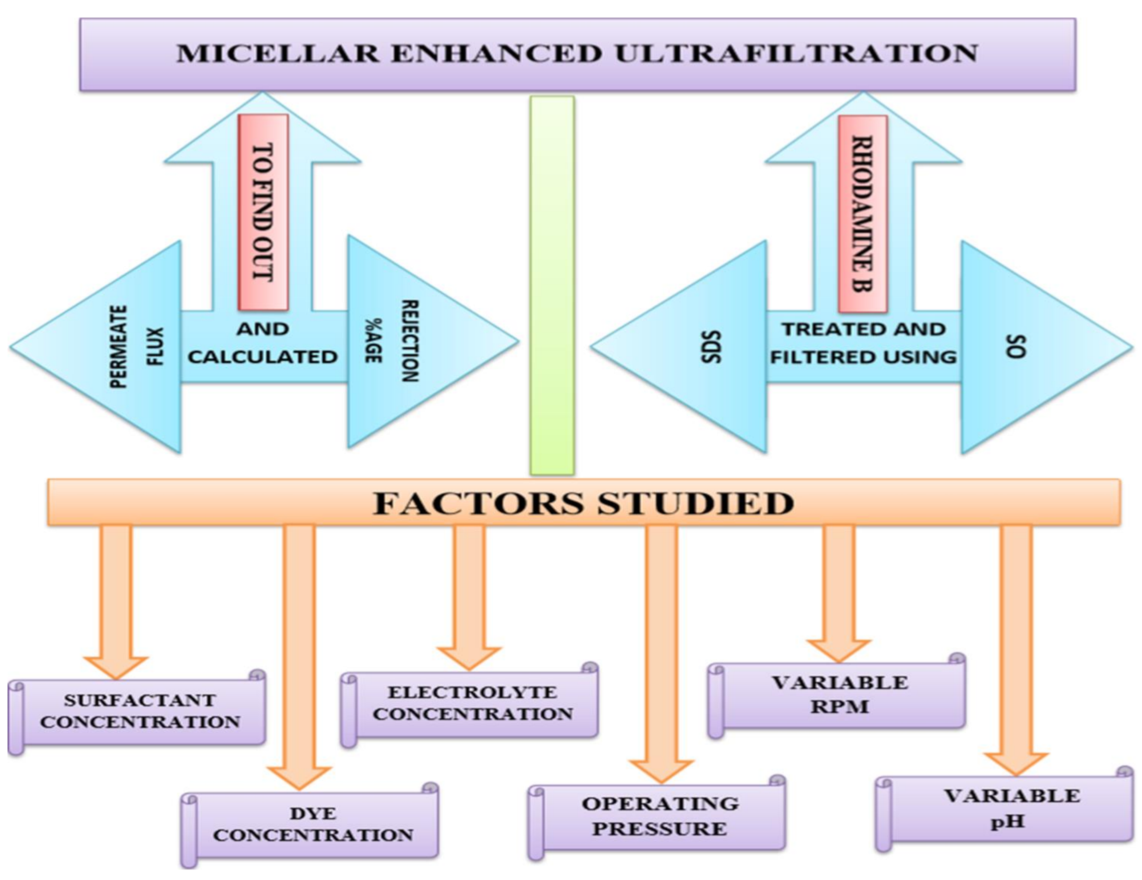
Where C_p and C_f stand for the concentration of pollutants in permeate and in feed solution respectively

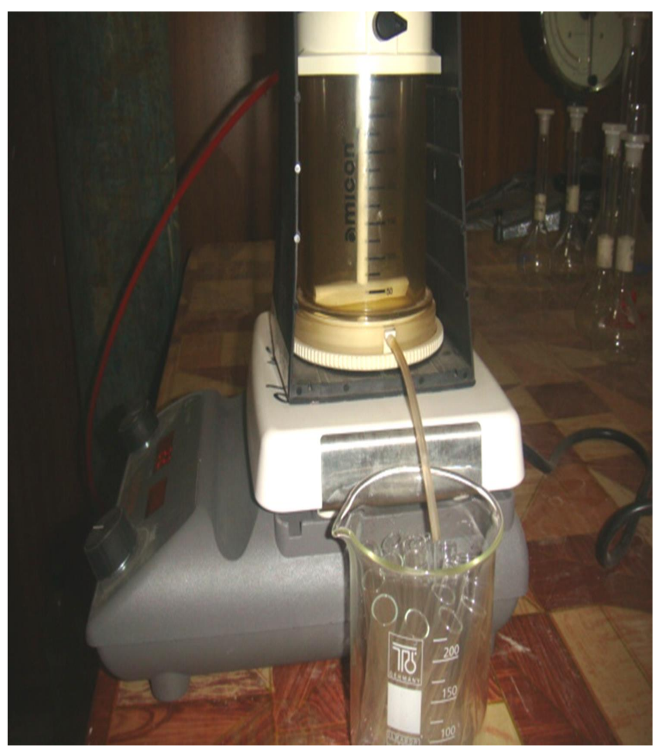
Distribution Coefficient (D)

Distribution co-efficient can be defined as the ratio of the concentration of pollutant in the retentate C_p and the permeate C_P:

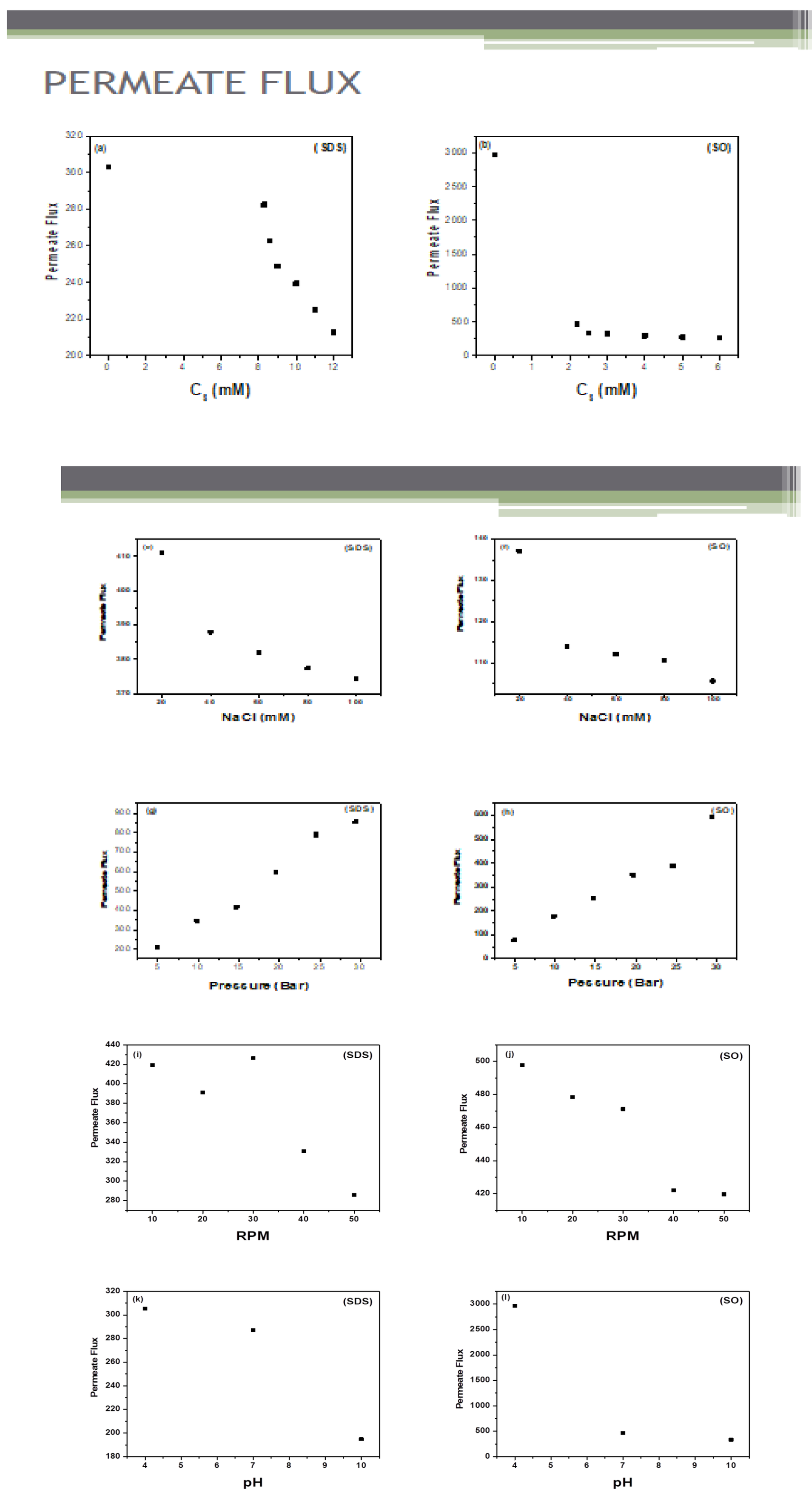
$$D = \frac{[C_P]_R}{[C_P]_P}$$

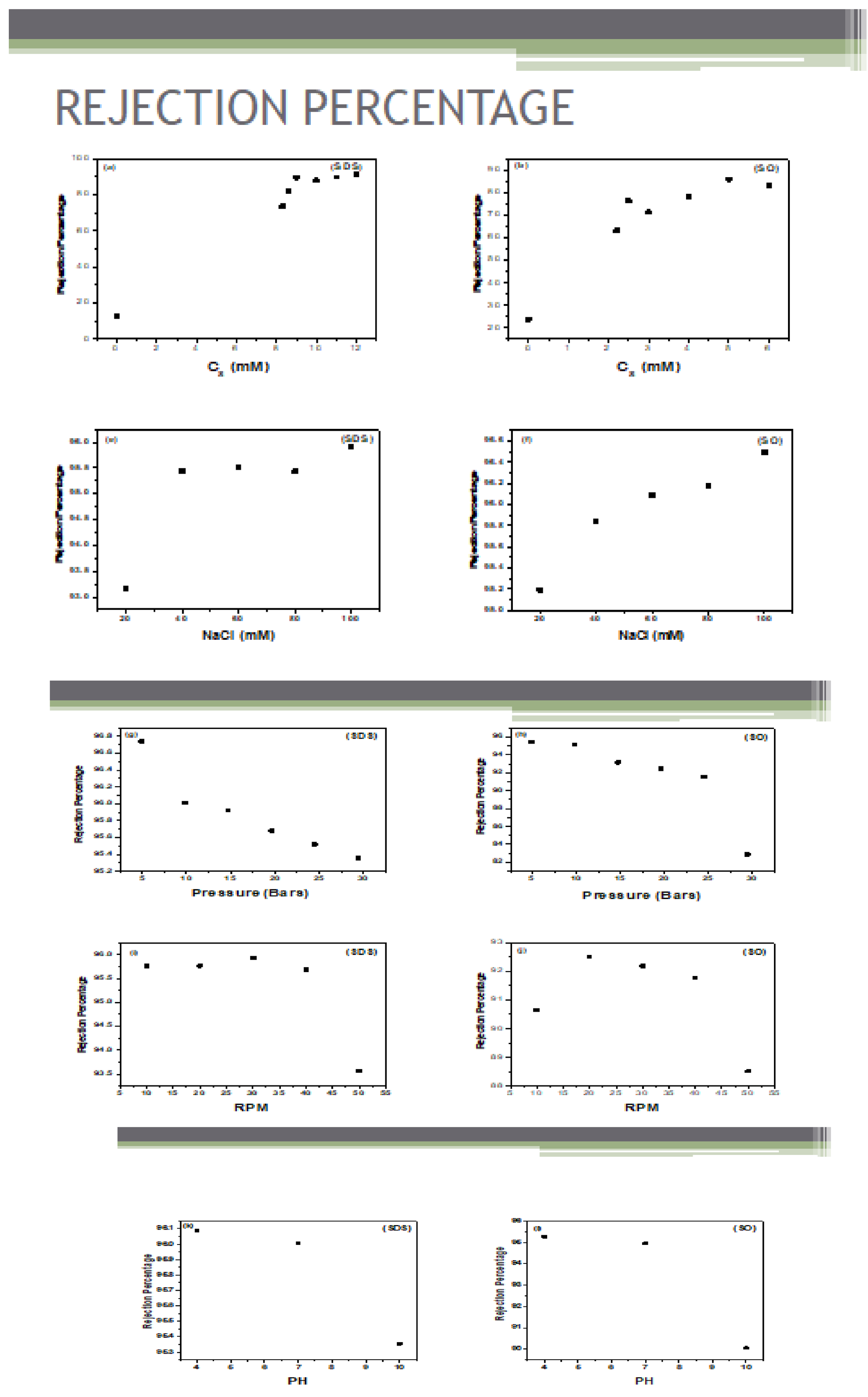
Where $[C_P]_R$ and $[C_P]_P$ stand for pollutant concentration in retentate and permeate respectively.

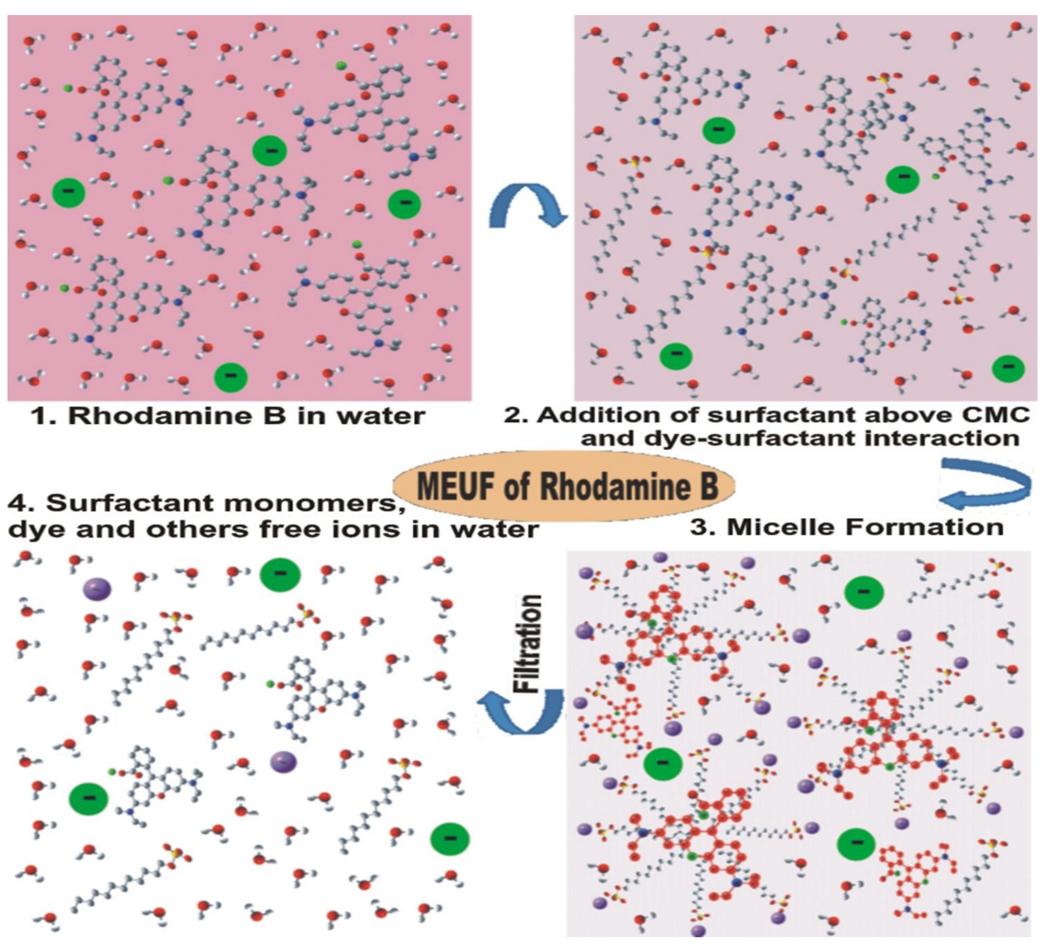




Results and Discussion







Sr. No.	Pressure (Bar)	C_f (mM)	C_p (µM)		R %		t (h)		V_p (ml)		J (L/hm²)	
			SDS	SO	SDS	SO	SDS	SO	SDS	SO	SDS	SO
1	5	0.04	1.30	1.83	96.74	95.44	0.34	1.53	30	50	211	78
2	10	0.04	1.60	1.96	96.00	95.11	0.20	0.67	30	50	345	179
3	15	0.04	1.63	2.74	95.92	93.16	0.17	0.47	30	50	417	252
4	20	0.04	1.73	3.03	95.68	92.42	0.12	0.34	30	50	599	352
5	25	0.04	1.79	3.39	95.51	91.52	0.09	0.30	30	50	790	389
6	30	0.04	1.86	6.84	95.35	82.89	0.08	0.20	30	50	856	592

Conclusion

Conclusion

The effective removal of dye, as a pollutant, from aqueous medium, has been comprehensively discussed by MEUF using micellar solutions of SDS and SO. Removal efficiency has been, quantitatively, expressed in terms of rejection coefficient and permeate flux being calculated under various experimental conditions. The effects of various factors, on efficiency of MEUF, have been studied. At one time, the effect of one variable is considered keeping values of other parameters constant to find best condition for dye removal. The dye elimination has been studied in range of 0-12mM concentration of SDS, 0-6mM concentration of SO, 20-100mM concentration of NaCl, 5-30 bars of pressure, 10-50 RPM and at the pH of 4, 7 and 10. Overall, the rejection coefficient was observed to increase at high concentration of surfactants, electrolyte and at low pH, RPM and transmembrane pressure, whereas, the permeate flux decreases at high (concentration of surfactant & electrolyte), RPM, pH and at low transmembrane pressure for both SDS and SO.

References

Hussain, K. I., Usman, M., Siddiq, M., Rasool, N., Nazar, M. F., Ahmad, I. & Altaf, A. A. Application of micellar enhanced ultrafiltration for the removal of sunset yellow dye from aqueous media. J Dispers Sci Technol. 2017, 38(1), 139-144.
Khan, A., Muhammad, A., Usman, M., Farooqi, Z.H., Zaman, K., Abdur, R., Amir, Z. The Interactions of Co-Solvent, Co-Solute and Amphiphilic Anionic Dye with Aqueous Solutions of Sodium Dodecyl Sulfate. Walailak J. Sci. & Tech. 2014, 12, 1107-1119.

Acknowledgment

HIGHER EDUCATION COMMISSION OF PAKISTAN (HEC)