

Dear Sir,

We want to produce ethanol by membrane bioreactor by pervaporation process. So, we need to permselective membrane to ethanol. After more investigation, we find that zeolite hydrophobic membranes are much useful for this study. According to discussion, highly hydrophobic zeolite membranes, such as silicalite-1, Ge-ZSM-5, and β -type have separated various organic compounds from water. For a binary system, ethanol permeated through the zeolite pores, but no water penetrated into the zeolite pores. Water, however, adsorbed on silanol groups along the external surface of the zeolite crystal. These results suggest that structural defects and non-zeolite pores in hydrophobic polycrystalline zeolite membranes increase water transport, and further improvements in organic separations from water may be possible. Table 1 shows results for ethanol removal from ethanol/water mixtures with various hydrophobic membranes.

The silicalite membrane with these spec are very ideal for us:

Separation factor (α) = 86 at fermentation broth having a 5 wt% ethanol concentration at PH = 4 and range temp = 25°C -45°C

So, the membranes with similar characteristic are useful and are red in table1.

Table1: ethanol removal from water

Membrane	Thickness (μm)	Support	EtOH in feed (%wt)	Temp. (K)	Flux ($\text{mol}/\text{m}^2\text{h}$)	α	Ref.
B-ZSM-5	100	$\alpha - \text{Al}_2\text{O}_3 / \text{SiC monolith}$	5	333	5.3	31	18
Ge-ZSM-5	30	SS	5	303	6.9	47	19
Silicalite-1	300	SS	10	303	2.9	31	20
ZSM-5	NA	$\alpha - \text{Al}_2\text{O}_3$	10	348	71	24	21
ZSM-11	30	$\alpha - \text{Al}_2\text{O}_3$	5	333	49	3.8	22
B-ZSM-11	25	SS	1	333	34	96	22
			5	333	30	42	
			25	333	28	10	
Silicalite-1	10	Mullite	10	333	65	72	23
Silicalite-1	NA	$\alpha - \text{Al}_2\text{O}_3$	5	303	12	94	24

	NA	$\alpha - Al_2O_3$	5	318	27	93	
	NA	$\alpha - Al_2O_3$	5	333	56	83	
	NA	$\alpha - Al_2O_3$	5	348	86	78	
Silicalite-1	20-30	Mullite	5	333	25	106	25
Silicalite-1	NA	$\alpha - Al_2O_3$	9.7	305	3.7	12	26
Silicalite-1 (silicone coated)	NA	SS	4	303	3.7	125	27
			4	313	6.6	119	
			4	323	8.8	110	
			4	333	14	100	
Silicalite-1 (before coating)	NA	SS	4	303	4.6	51	27
Silicalite-1	60	SS	4	303	9.5	70	28
Silicalite-1	400	SS	4.7	303	18	65	29
			10	303	19	36	
			20	303	19	29	
Silicalite-1 (silane modified)	NA	SS	4	303	8.6	40	30
			4	313	14	40	
			4	323	22	44	
Silicalite-1 (before silane)	NA	SS	4	303	32	15	30
Silicalite-1	400	SS	2.4	303	6.2	67	31
			4	303	6.2	63	
			8	303	5.7	59	
			11	303	5.9	57	
			17	303	5.5	50	
			2.5	333	27	52	
Silicalite-1	400	SS	4	333	24	59	32
B-ZSM-5	NA	SS	5	333	3.4	10	33

SS: stainless steel; NA: not available

In addition to, three types of hydrophobic polymeric membrane is useful for removal ethanol from water that is mentioned follow and we need them too:

1- PTMSP [poly(1-trimethylsilyl-1-propyne)] membrane

Separation factor = 10.5-12

Temp.= 30°C

Ethanol wt% = 10%

Thickness= 30-100µm

2- PDMS [polydimethylsiloxane]

Separation factor = 10.8

Temp.= 30°C

Ethanol wt% = 8%

3- PDMS-PPP graft copolymer [polydimethylsiloxane-poly(1-phenyl-1-propyne)]

Separation factor = 40

Temp.= 30°C

Ethanol wt% = 7%

We want 2 discs with diameter 14 cm from each membrane.

Your sincerely