

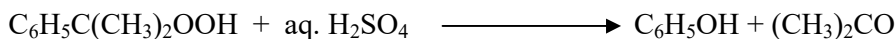
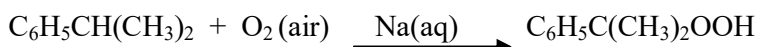
PRODUCTION OF PHENOL FROM CUMENE

Akash Goyal
Department of Chemical Engineering
Visvesvaraya National Institute of Technology, Nagpur
Email: goyalakash@gmail.com

INTRODUCTION:

Phenol, also known as benzenol is used in manufacturing of plastic, paints coating and disinfectants etc. It is also a starting material for making explosives and drugs such as aspirin. Phenol can be by processes like hydrolysis of chlorobenzene or liquid phase oxidation of toluene, but the most dominating process is preparation through cumene.

REACTION:



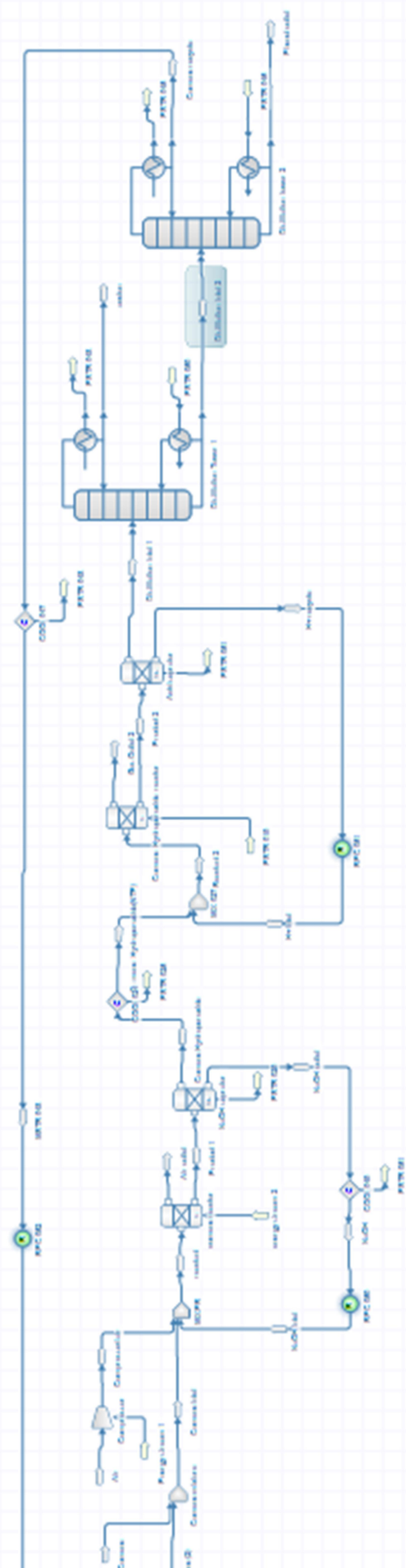
PROCESS DESCRIPTION:

Fresh cumene and recycled cumene are mixed in mixer, then this mixture along with compressed air and NaOH are mixed and then sent to cumene reactor. This gives cumene hydroperoxide with 80% conversion and air is sent out from the top.

NaOH is recycled back to the mixer through NaOH separator. Cumene hydroperoxide is then cooled to room temperature and fed to cumene hydroperoxide reactor in presence of H^+ inlet. This results in formation of crude phenol and acetone and after that H^+ is recycled back to reactor.

Distillation tower 1 separates acetone from crude phenol (Distillation 1). Then bottom product (distillation 2) is fed to distillation tower 2 where cumene and phenol are separated. Cumene is recycled back to cumene mixture and finally pure phenol is obtained.

PROCESS FLOWSHEET:



STREAM DATA:

Stream		Cumene	Cumene Inlet	Air	Compressed Air	NaOH Inlet	Reactant	Air Outlet
Temperature (°C)		25	25	25	33.3158	25	25.047	25.0474
Pressure (KPa)		100	100	20,078.00	30,078.00	101.325	100	100
Mass Flow (Kg/d)		112,000	140,000	40,000.00	40,000.00	10,000	190,000	10,222.45
Molar Flow (Kmol/d)		931.83	1,164.78	1,250.04	1,250.04	250.02	2,664.84	318.53
Volumetric Flow (M ³ /d)		130.2903	162.8629	142.52	105.89	4.6948	31,318.49	7,896.93
Mole Flow (Kmol/d)	cumene	931.826	1164.783	0.00	0.00	0	1164.783	0.34
	Oxygen	0	0	1,250.04	1,250.04	0	1250.04	318.19
	Cumene hydroperoxide	0	0	0.00	0.00	0	0	0.00
	Phenol	0	0	0.00	0.00	0	0	0.00
	Acetone	0	0	0.00	0.00	0	0	0.00
	Sodium Hydroperoxide	0	0	0.00	0.00	250.018	250.018	0.00
	Hydrogn	0	0	0.00	0.00	0	0	0.00

Product1	NaOH Outlet	Cumene Hydroperoxide	Cumene Hydroperoxide(NTP)	H+ Inlet	Reactant 2	Gas Outlet 2	Product 2
25.0474	25.047	25.047	25	1,726.85	25.000012	25.000012	25.000012
100	100	100	100	101.325	101.325	101.325	101.325
179,777.55	10,000.15	169,777.40	169,777.40	5,000.00	174,777.40	0.00	174,777.40
1,414.51	250.02	1,164.49	1,164.49	4,963.32	6,127.81	0.00	7,059.54
173.16	4.69	168.60	168.59	0.00	168.46	0.00	183.14
232.62	0.00	232.62	232.62	0.00	232.62	0.00	232.62
0.03	0.00	0.03	0.03	0.00	0.03	0.00	0.03
931.84	0.00	931.84	931.84	0.00	931.84	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	931.82
0.00	0.00	0.00	0.00	0.00	0.00	0.00	931.82
250.02	250.02	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	100.00	100.00	0.00	99.99

H+ Recycle	Distillation Inlet 1	Acetone	Distillation Inlet 2	Phenol Outlet	Cumene Recycle	Recycled Cumene
25.000012	25.000012	0.8114	175.525	181.296	153.134	25
101.325	101.325	101.325	101.325	101.325	101.325	101.325
4,999.92	169,777.48	54,121.36	115,656.12	87,696.82	27,959.30	28,000.00
4,963.24	2,096.29	931.86	1,164.44	931.82	232.62	232.96
0.00	183.14	66.51	132.77	94.53	6,111.76	32.57
0.00	232.62	0.00	232.63	0.00	232.62	232.96
0.00	0.03	0.03	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	931.82	0.00	931.82	931.82	0.00	0.00
0.00	931.82	931.82	0.80	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
99.99	0.00	0.00	0.00	0.00	0.00	0.00

REFERENCES:

<https://dwsim.fossee.in>

www.google.com

Dryden's Outline of Chemical Technology