Robust design and control of extractive distillation processes under feed disturbances

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- Basis of cost estimation (Table S1)
- Design and operating conditions for various values of the benzene wt % in the feed mixture for deterministic cases (Table S2).

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Table S1. Basis of cost estimation	
Equipment	Cost Model
Column shell	$c_1(\$) = 17640(ID_C)^{1.066}(L)^{0.802}$ $L = N \times 0.61 \times 1.2$
Condenser	$c_2(\$) = 7296(A_C)^{0.65}$ $A_C = \frac{Q_C}{U_C \times \Delta T_C}$, U_C = 0.852 kW.K^{-1}.m^{-2} $\Delta T_C = \frac{(T_{RD} - T_{out}^{cw}) - (T_{RD} - T_{in}^{cw})}{\log \frac{(T_{RD} - T_{out}^{cw})}{(T_{RD} - T_{in}^{cw})}}$
Reboiler	$c_3(\$) = 7296(A_R)^{0.65}$ $A_R = \frac{Q_R}{\min(U_R \times \Delta T_R, (Q_R/A_R)_{\max})}$, $(Q_R/A_R)_{\max} \sim 32 kW/m^2$ U_R = 0.852 kW.K^{-1}.m^{-2} , $\Delta T_R = T_{Stm} - T_R$
Utility cost LP steam (433 K, 6 bar) = 7.78 $/GJ MP steam (457 K, 11 bar) = 8.22 $/GJ	

Table S2. Results of the optimization for deterministic cases					
x_{Feed}^{B}	**55**	**60**	**65**	**70**	**75**
N_1	2	2	2	2	2
N_2	26	30	24	26	26
N_3	16	15	15	14	14
N_4	4	4	4	4	4
N_5	4	4	4	4	4
$x_{D_1}^{B}$ [wt %]	99.00	99.00	99.00	99.00	99.00
$x_{D_2}^{A}$ [wt %]	99.90	99.90	99.90	99.90	99.90
RR^{C_1}	1.752	1.684	1.362	1.229	1.208
RR^{C_2}	0.263	0.303	0.433	0.563	0.713
ID_{C_1} [m]	0.951	0.970	0.974	0.983	1.002
ID_{C_2} [m]	0.791	0.759	0.761	0.735	0.697
Solvent [kg/hr]	7626.3	7479.0	8952.9	9252.8	9206.6
Makeup [kg/hr]	0.504	0.447	0.675	0.647	0.691
$Q_C^{C_1}$ [kW]	-619.2	-659.0	-628.3	-638.5	-677.9
$Q_C^{C_2}$ [kW]	-430.8	-393.8	-377.9	-351.5	-319.0
$Q_R^{C_1}$ [kW]	922.8	968.4	1017.0	1062.4	1119.7
$Q_R^{C_2}$ [kW]	548.1	497.2	484.6	440.5	388.6
Hx duty [kW]	-431.0	-422.5	-505.3	-522.1	-519.6
Capital cost [10^5 $]	7.333	7.496	7.240	7.332	7.432
Operating costs [10^5 $/yr]	3.365	3.347	3.426	3.423	3.429
TAC [10^5 $/yr]	5.809	5.846	5.839	5.867	5.906