Supplementary Material

Influence of Estimators and Numerical Approaches on the Implementation of NMPCs

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S.I   Control Results

In the current material, the results related to the combination of the MHE, CEKE, and EKF estimators with the NMPCs based on SS, MS, and OC are shown. Each one of the nine combinations were simulated by considering six cases: set-point changes, unreachable set-point, change in $C_{A,in}$, pulses in T_{in}, and mismatches in k_{01} and C_P. This material is organized by presenting the results for each combination in a specific section, departing from section S.I.1 for combination 1 to S.I.9 for combination 9.

S.I.1   Combination 1: SS and EKF
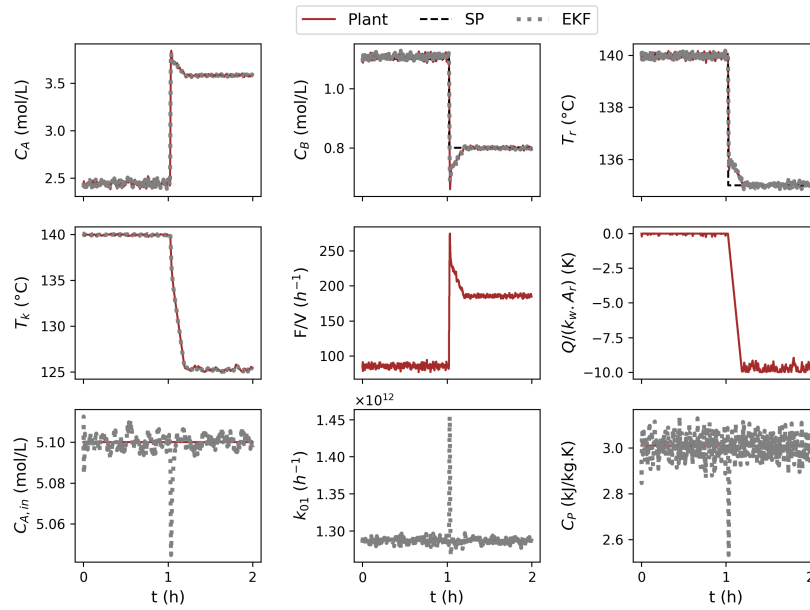
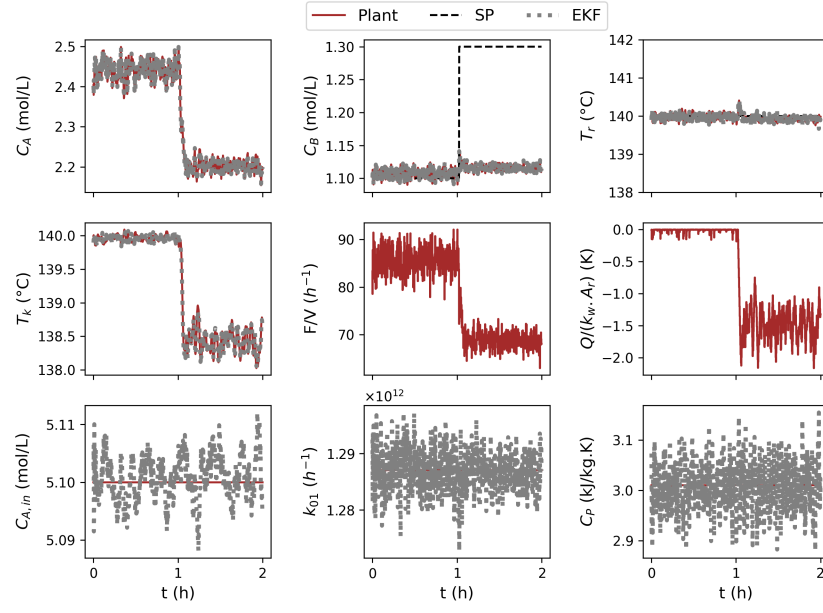Figure S.1: Simulation for combination 1 and case 1, considering set-point changes.

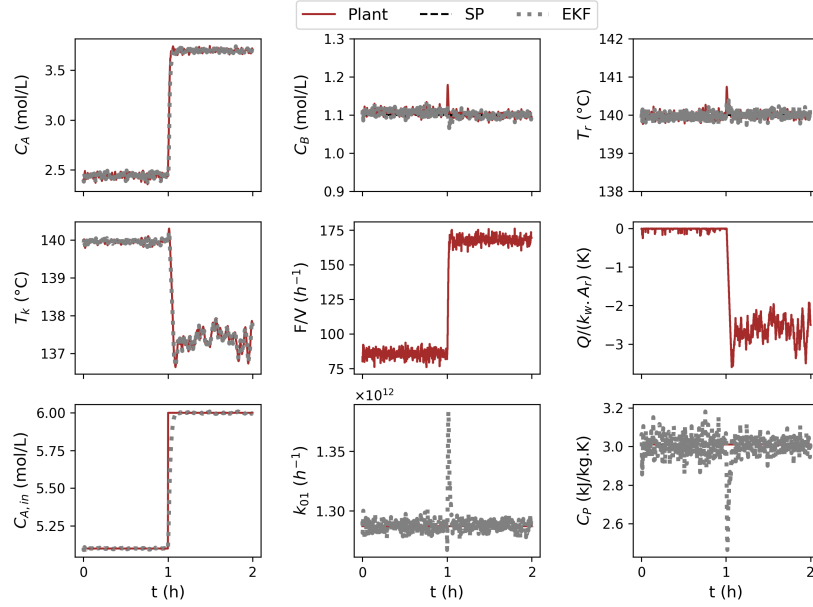Figure S.2: Simulation for combination 1 and case 2, considering unreachable set-point.

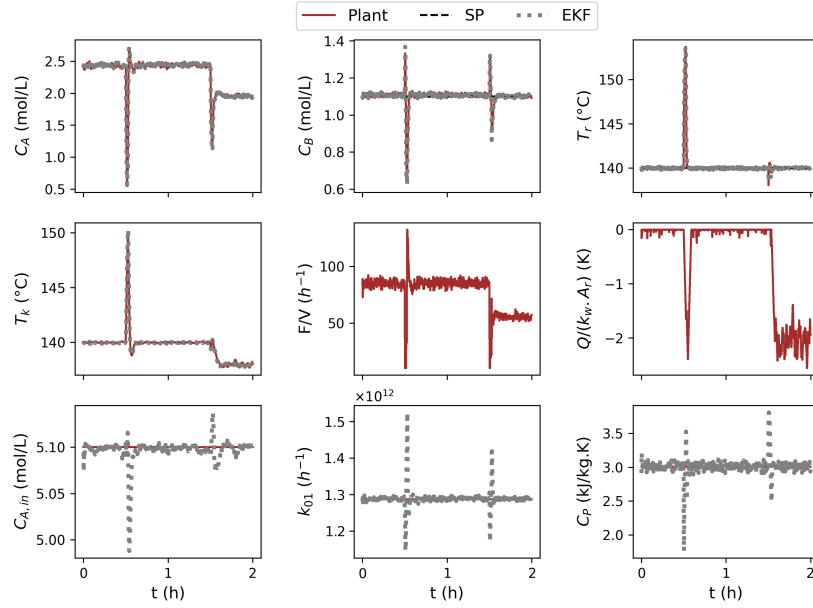Figure S.3: Simulation for combination 1 and case 3, considering a change in $C_{A,in}$.

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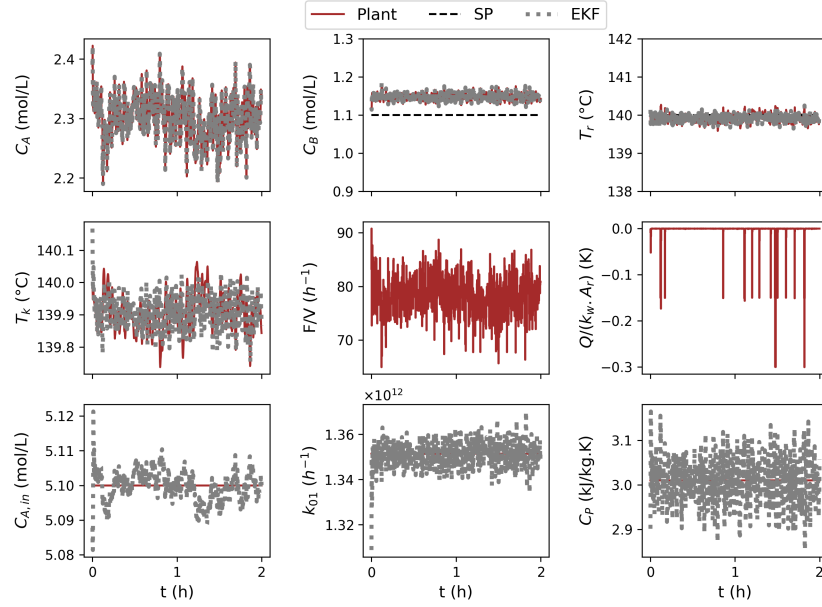Figure S.4: Simulation for combination 1 and case 4, considering changes in T_{in}.

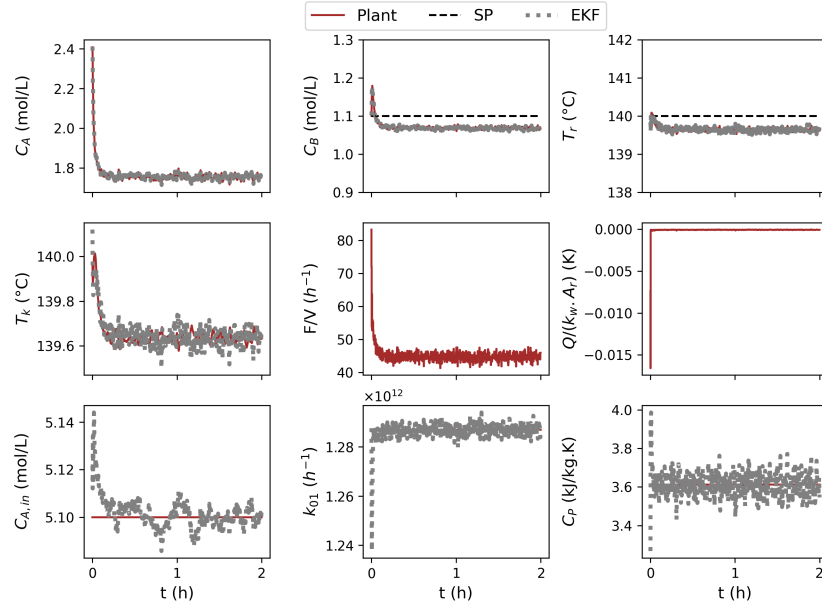Figure S.5: Simulation for combination 1 and case 5, considering mismatch in k_{01}.

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Figure S.6: Simulation for combination 1 and case 6, considering mismatch in C_P.
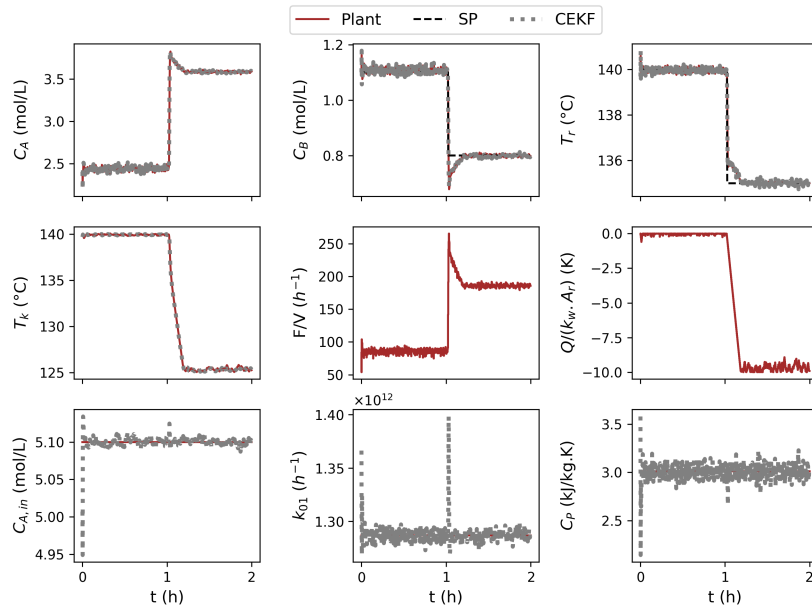
S.I.2 Combination 2: SS and CEKF

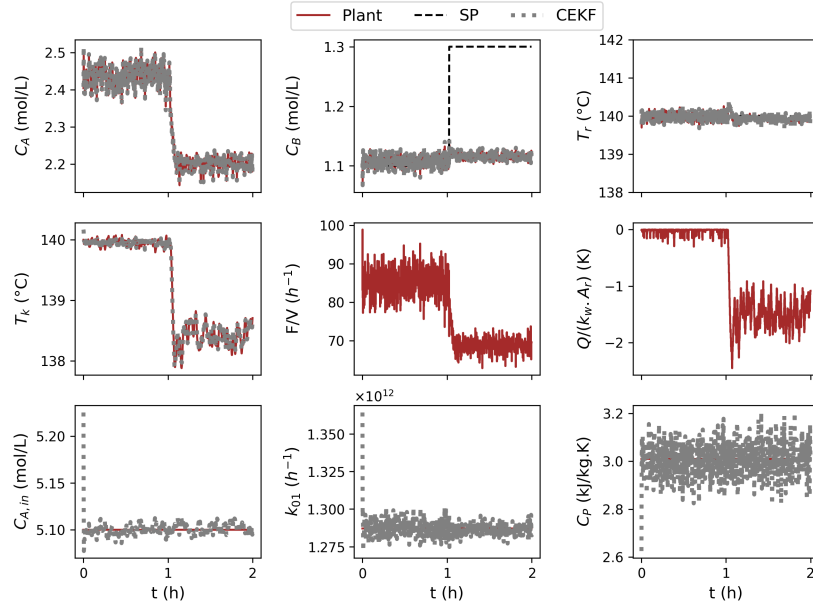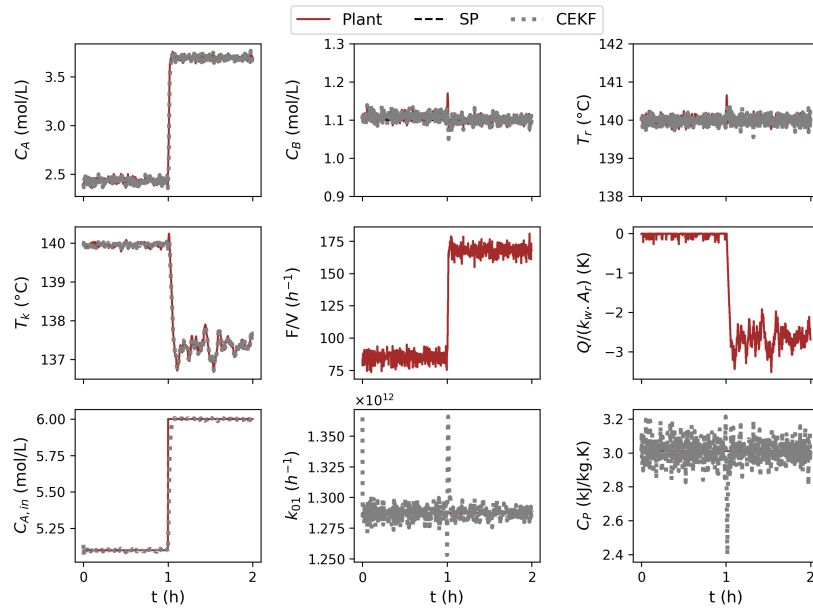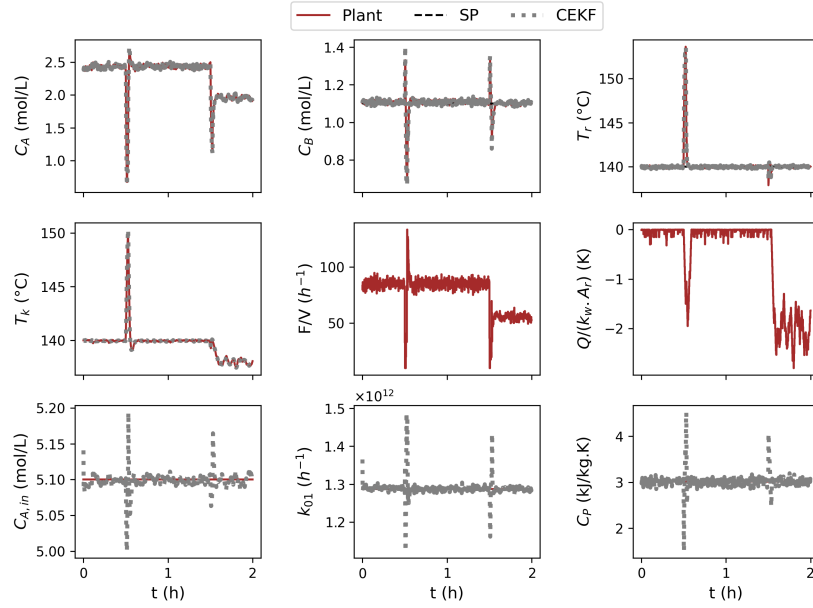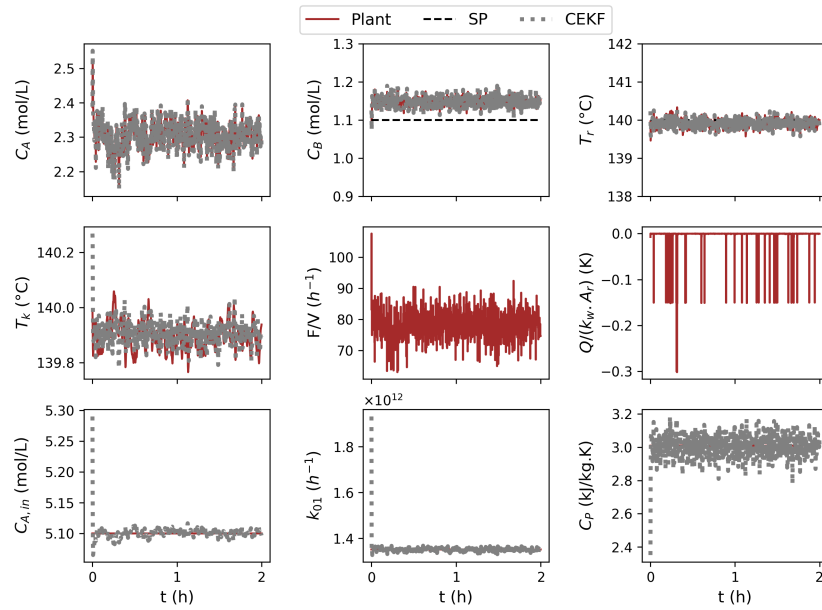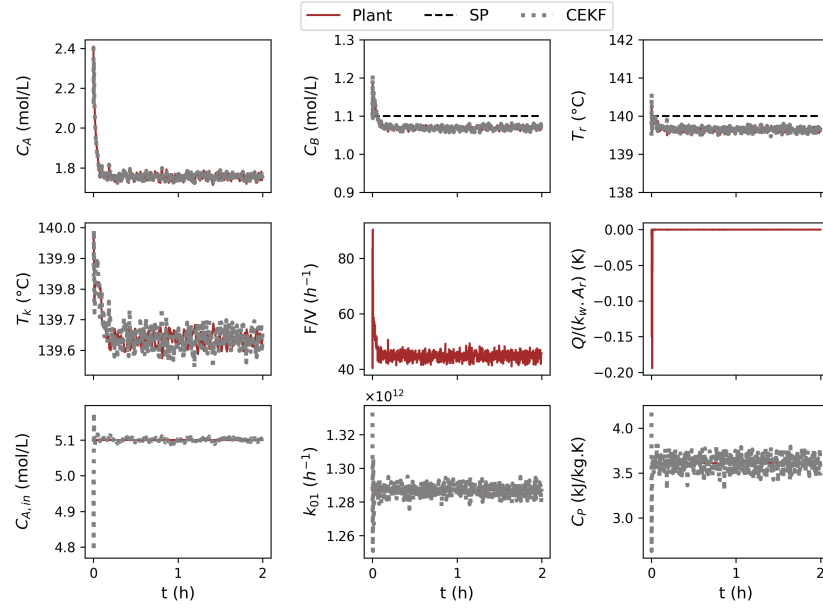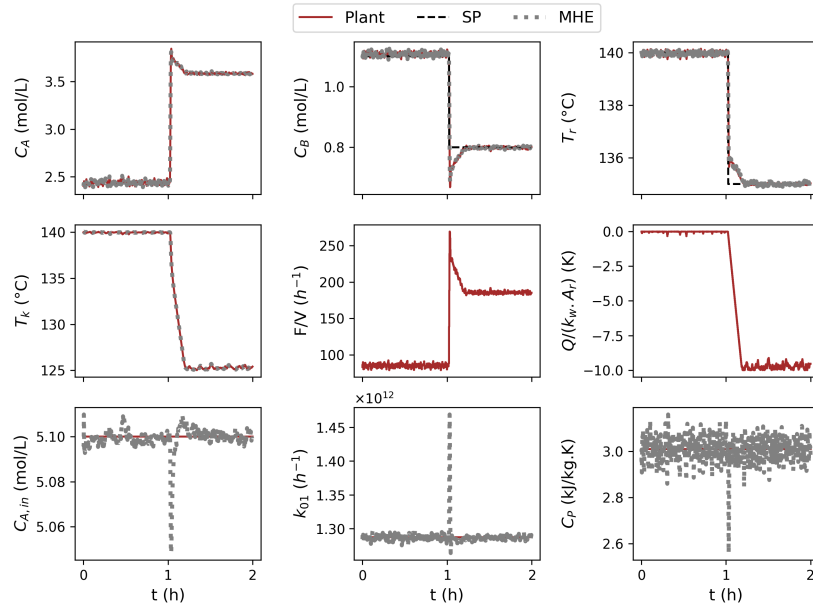Figure S.7: Simulation for combination 2 and case 1, considering set-point changes.

Figure S.8: Simulation for combination 2 and case 2, considering unreachable set-point.

Figure S.9: Simulation for combination 2 and case 3, considering a change in $C_{A,in}$.

Figure S.10: Simulation for combination 2 and case 4, considering changes in T_{in}.

Figure S.11: Simulation for combination 2 and case 5, considering mismatch in k_{01}.

Figure S.12: Simulation for combination 2 and case 6, considering mismatch in C_P.

S.I.3 Combination 3: SS and MHE

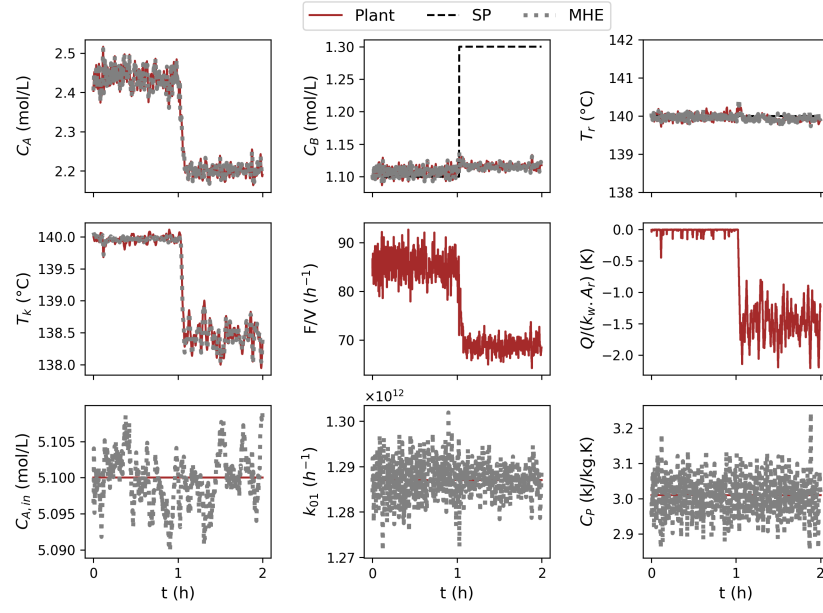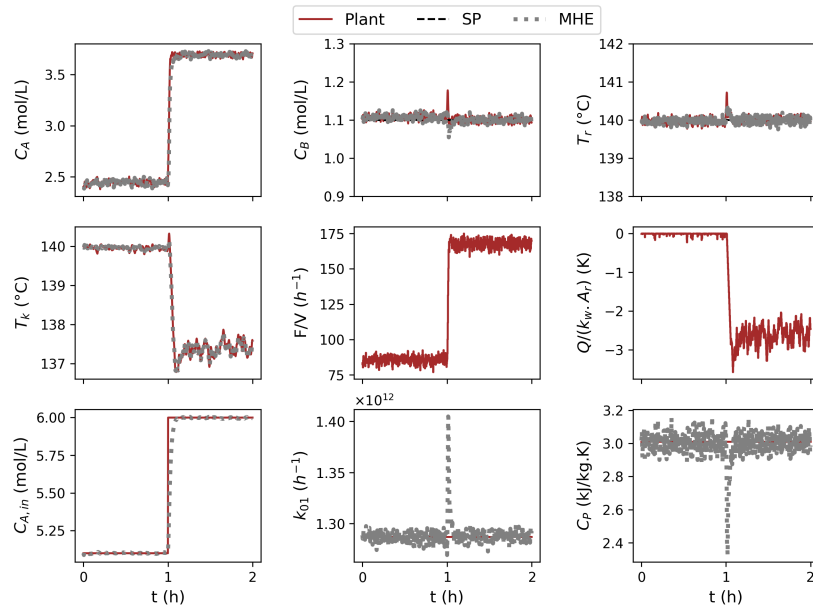Figure S.13: Simulation for combination 3 and case 1, considering set-point changes.

Figure S.14: Simulation for combination 3 and case 2, considering unreachable set-point.

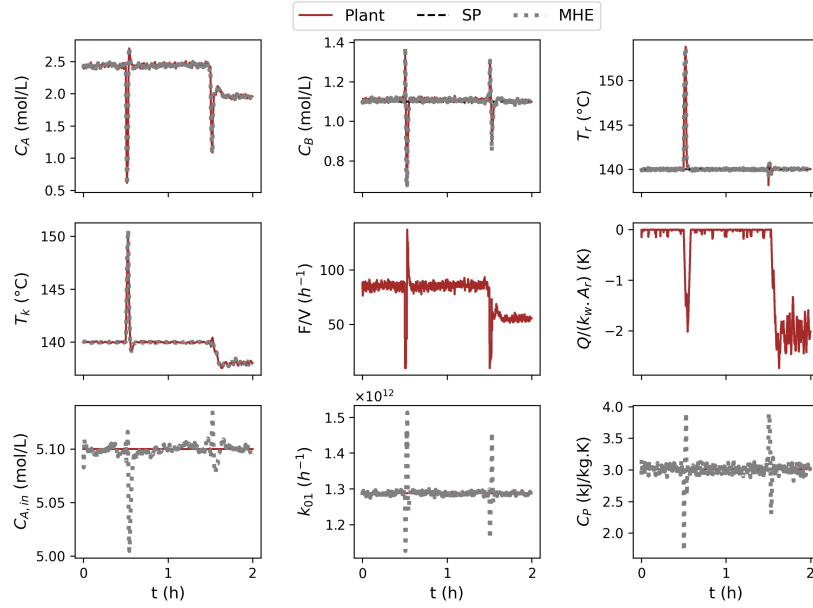Figure S.15: Simulation for combination 3 and case 3, considering a change in $C_{A,in}$.

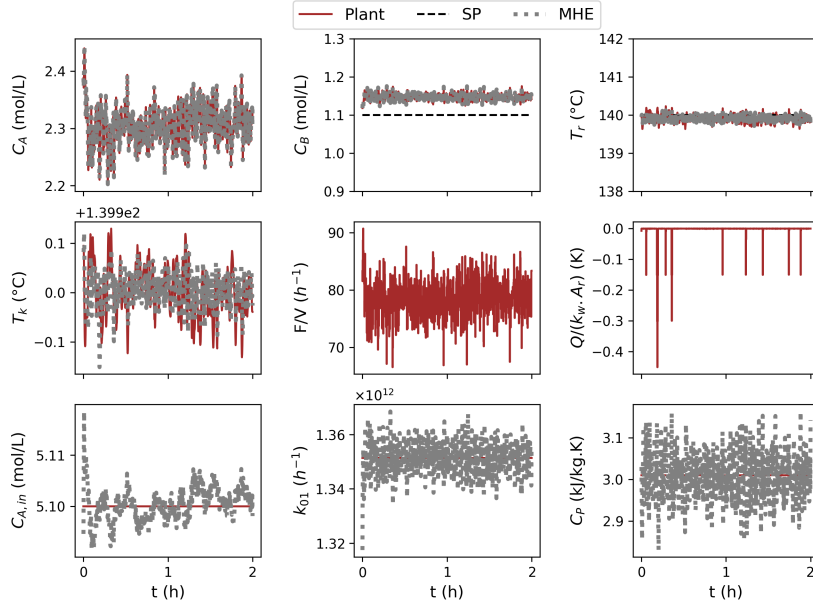Figure S.16: Simulation for combination 3 and case 4, considering changes in T_{in}.

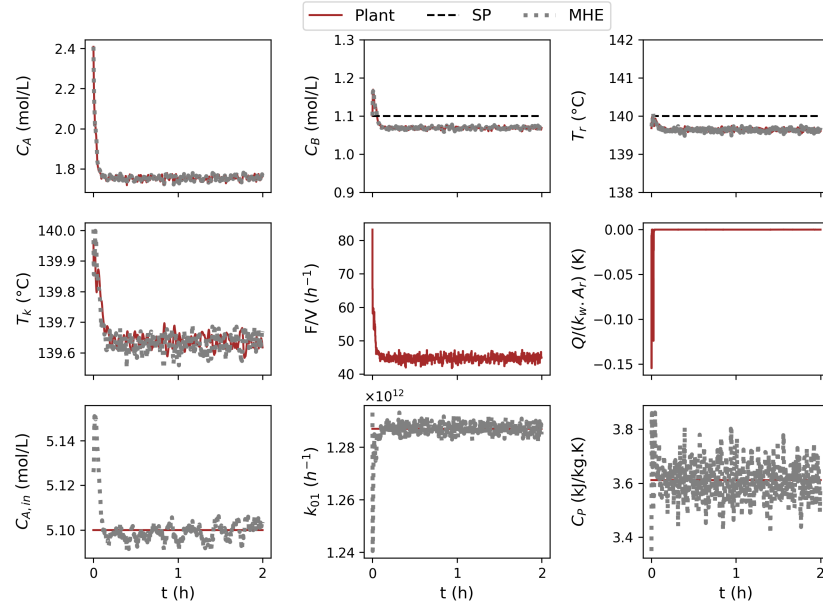Figure S.17: Simulation for combination 3 and case 5, considering mismatch in k_{01}.

Figure S.18: Simulation for combination 3 and case 6, considering mismatch in C_P.
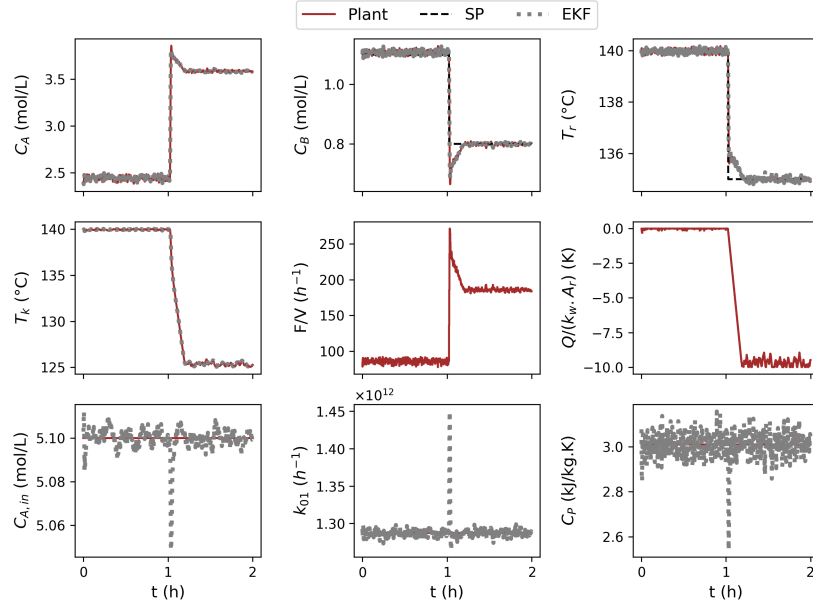
S.I.4   Combination 4: MS and EKF

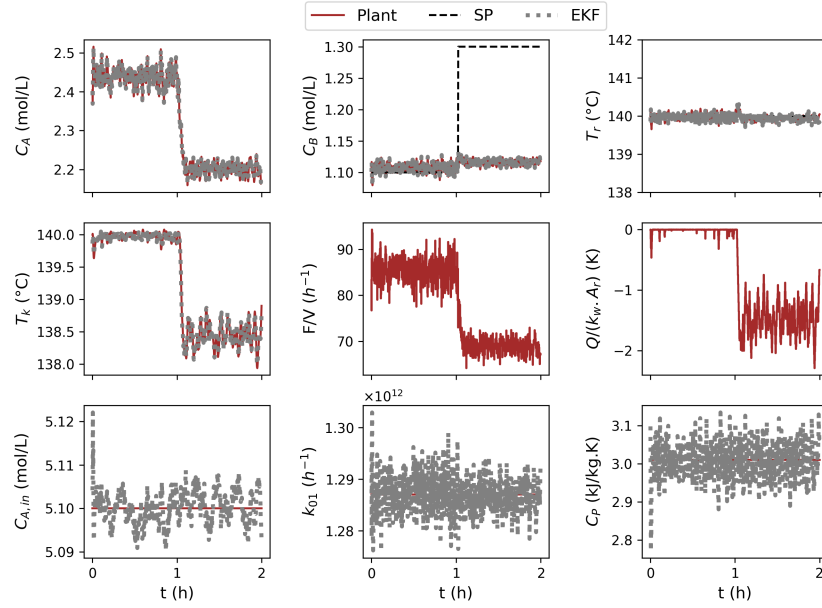Figure S.19: Simulation for combination 4 and case 1, considering set-point changes.

Figure S.20: Simulation for combination 4 and case 2, considering unreachable set-point.
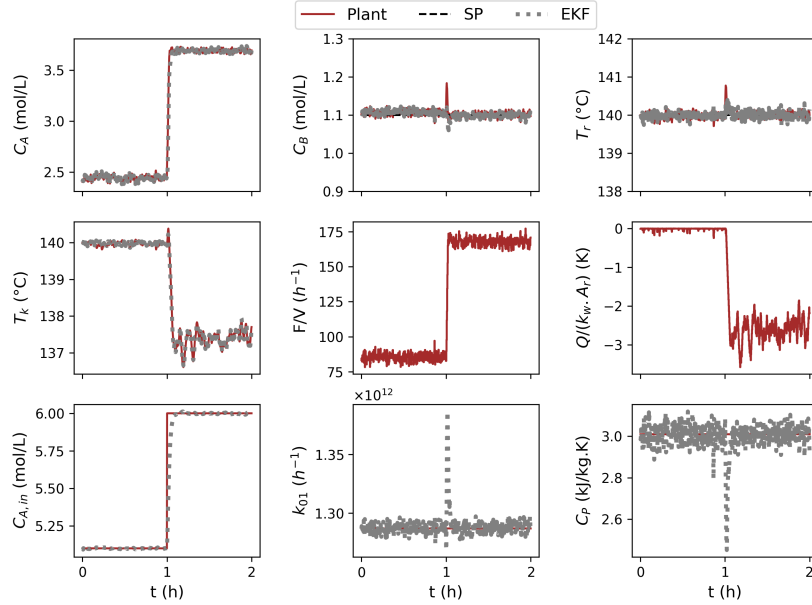

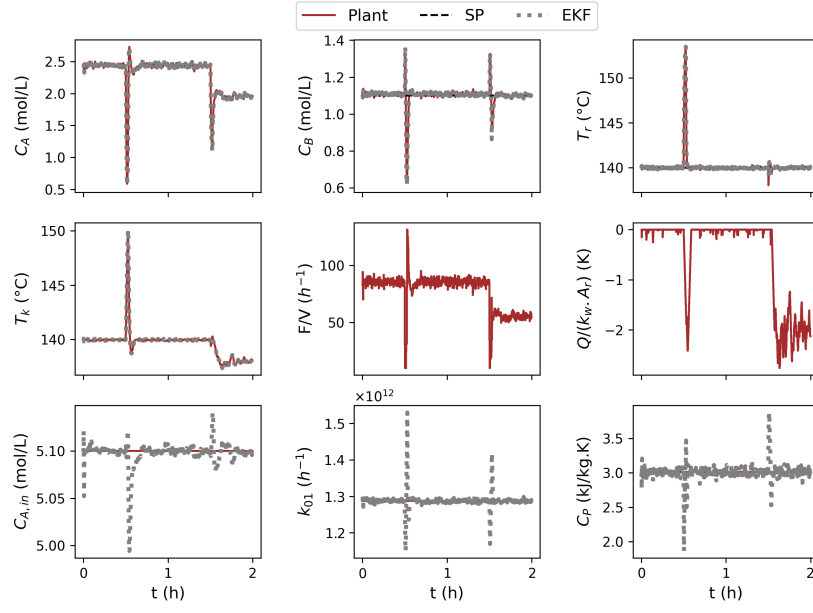Figure S.21: Simulation for combination 4 and case 3, considering a change in $C_{A,in}$.

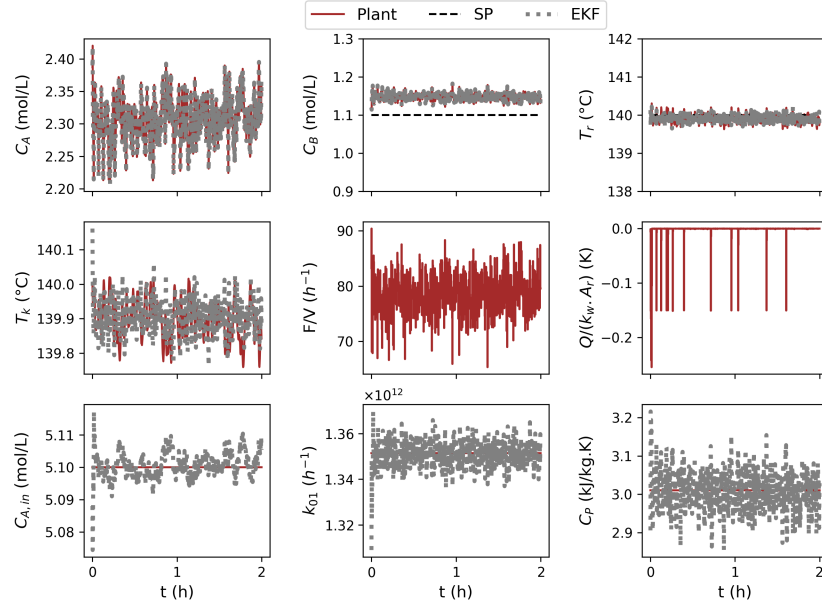Figure S.22: Simulation for combination 4 and case 4, considering changes in T_{in}.

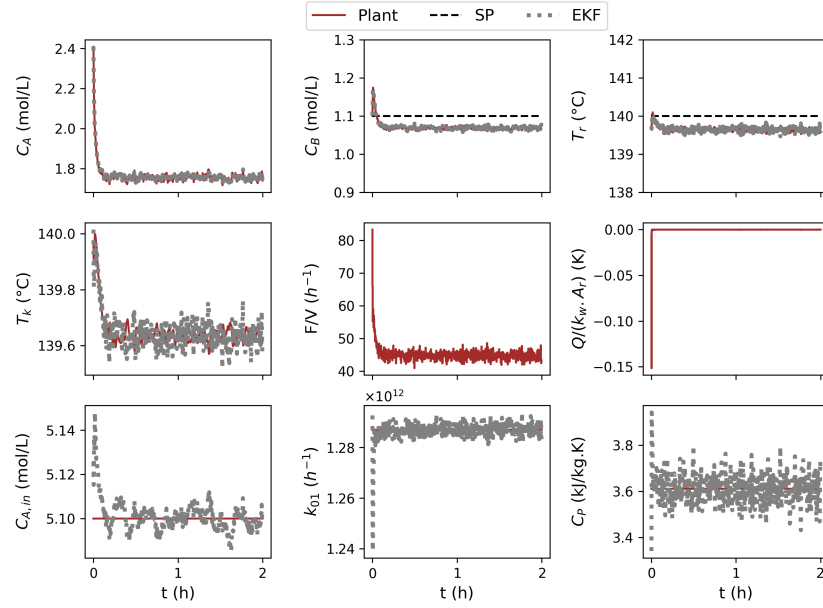Figure S.23: Simulation for combination 4 and case 5, considering mismatch in k_{01}.

Figure S.24: Simulation for combination 4 and case 6, considering mismatch in C_P.
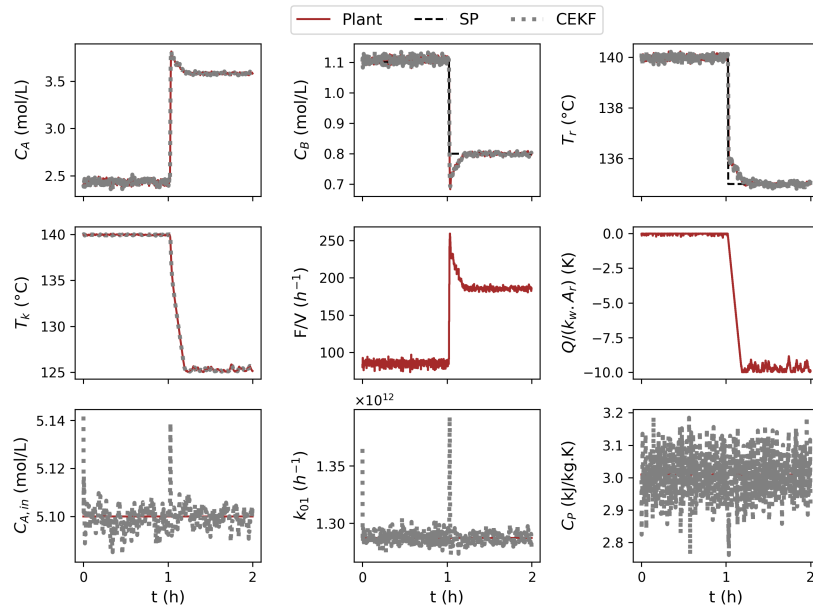
S.I.5   Combination 5: MS and CEKF

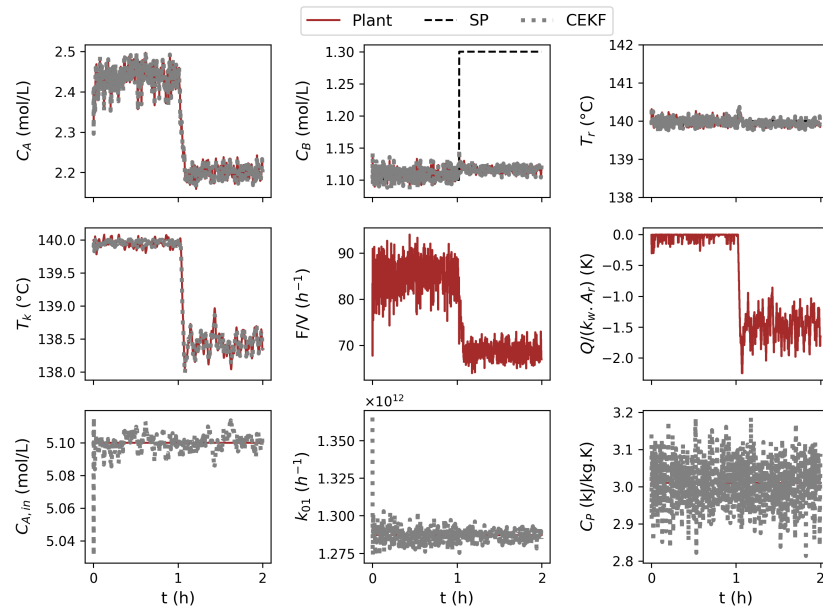Figure S.25: Simulation for combination 5 and case 1, considering set-point changes.

Figure S.26: Simulation for combination 5 and case 2, considering unreachable set-point.
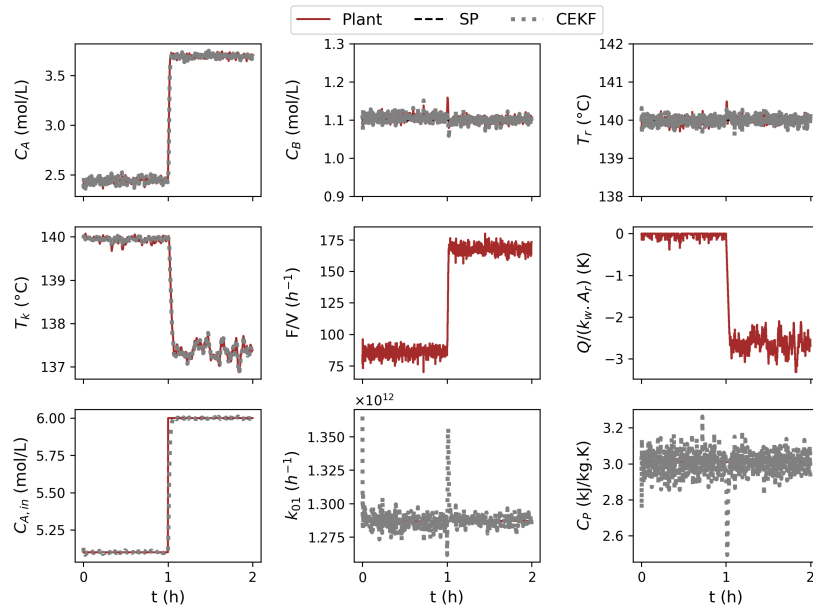

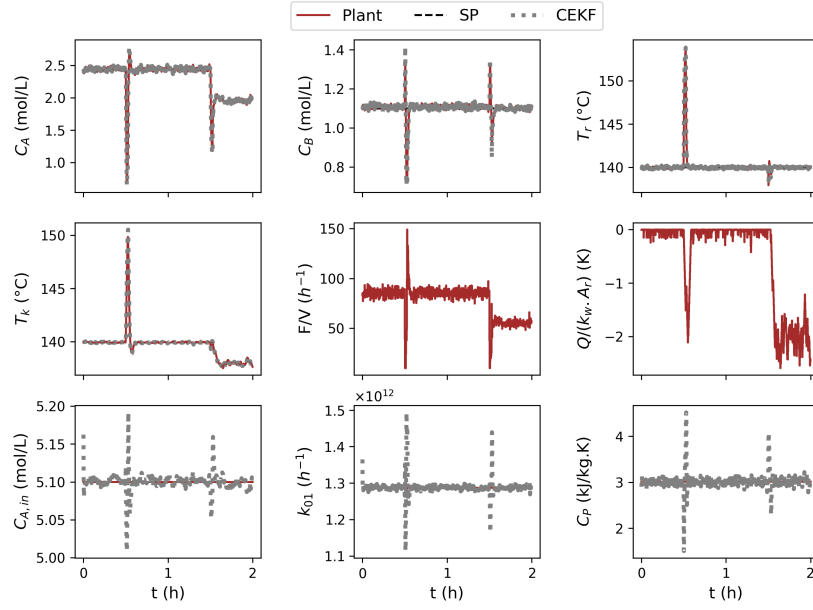Figure S.27: Simulation for combination 5 and case 3, considering a change in $C_{A,in}$.

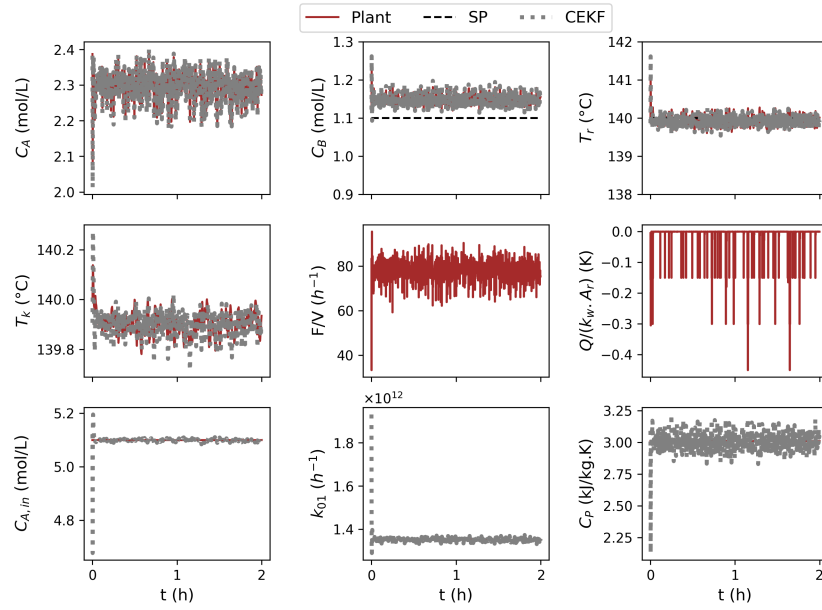Figure S.28: Simulation for combination 5 and case 4, considering changes in T_{in}.

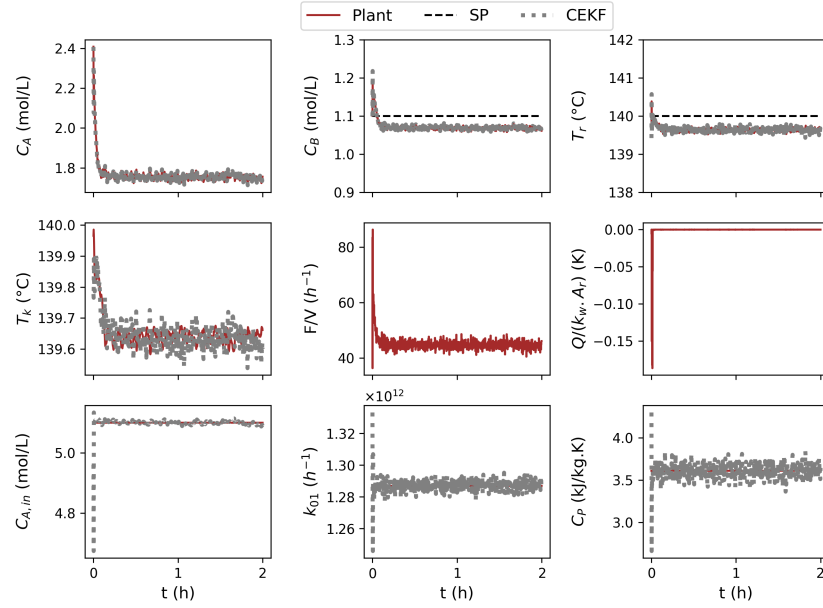Figure S.29: Simulation for combination 5 and case 5, considering mismatch in k_{01}.

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Figure S.30: Simulation for combination 5 and case 6, considering mismatch in C_P.
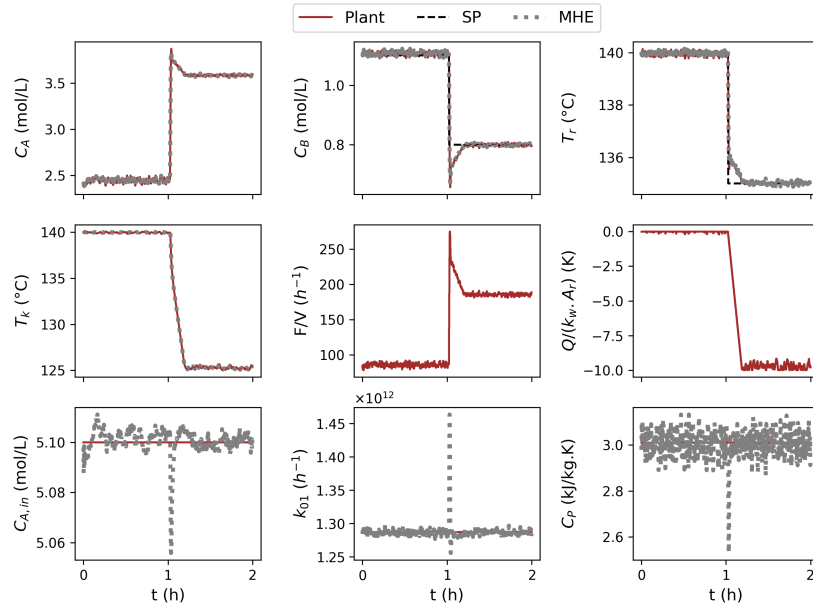
S.I.6 Combination 6: MS and MHE

Figure S.31: Simulation for combination 6 and case 1, considering set-point changes.
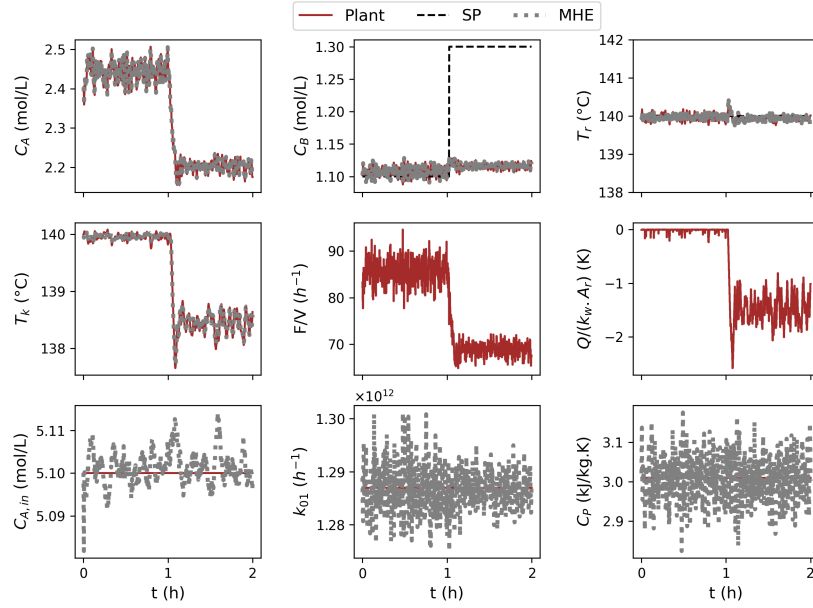
Figure S.32: Simulation for combination 6 and case 2, considering unreachable set-point.
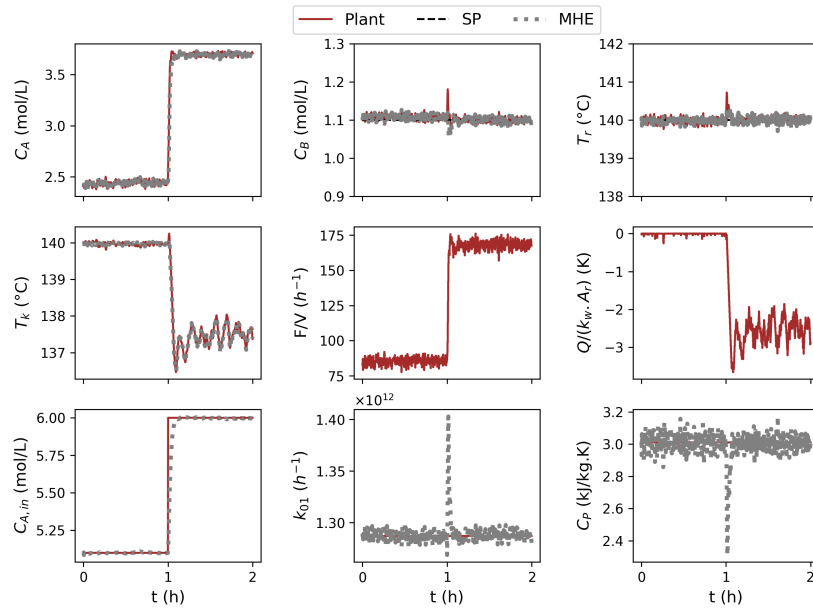

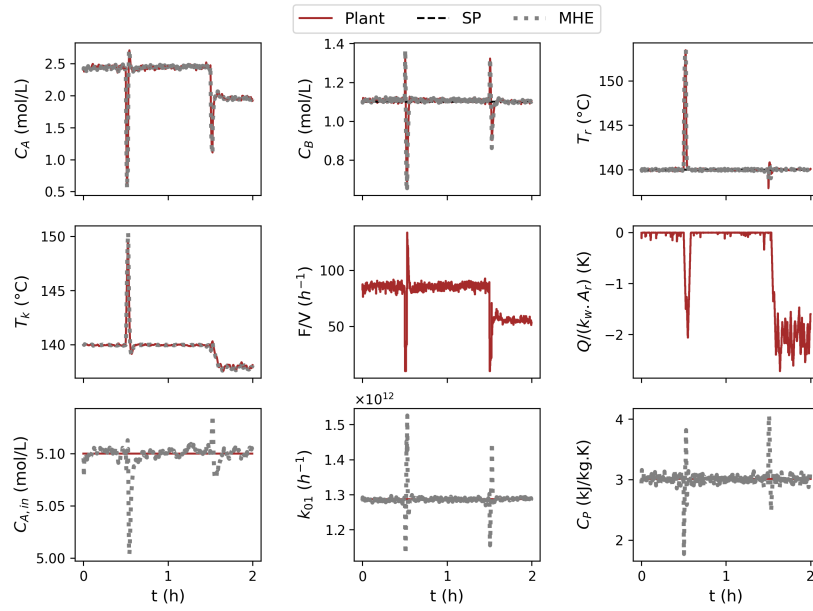Figure S.33: Simulation for combination 6 and case 3, considering a change in $C_{A,in}$.

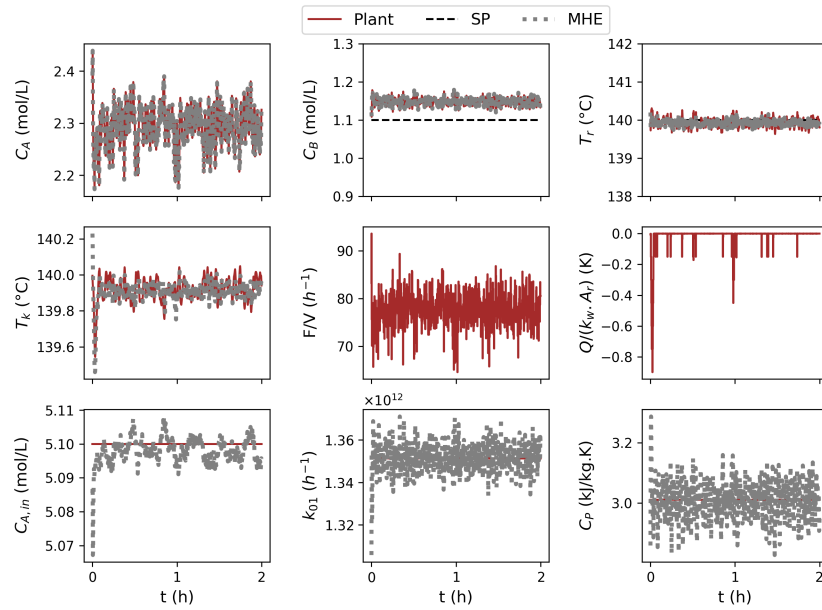Figure S.34: Simulation for combination 6 and case 4, considering changes in T_{in}.

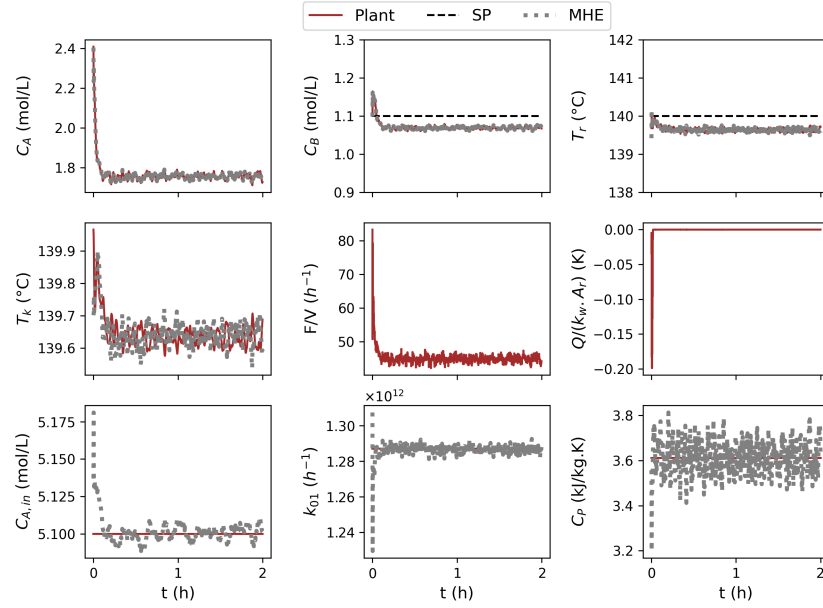Figure S.35: Simulation for combination 6 and case 5, considering mismatch in k_{01}.

Figure S.36: Simulation for combination 6 and case 6, considering mismatch in C_P.
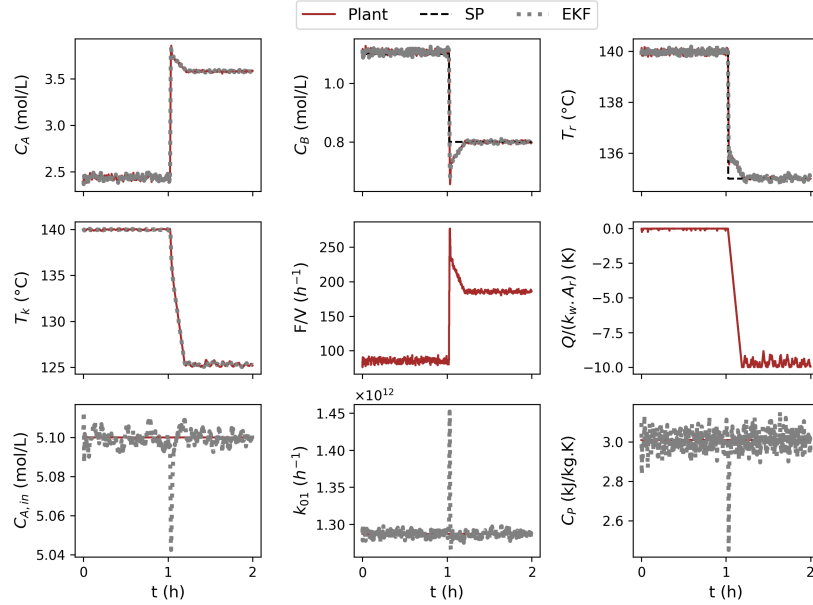
S.I.7 Combination 7: OC and EKF

Figure S.37: Simulation for combination 7 and case 1, considering set-point changes.
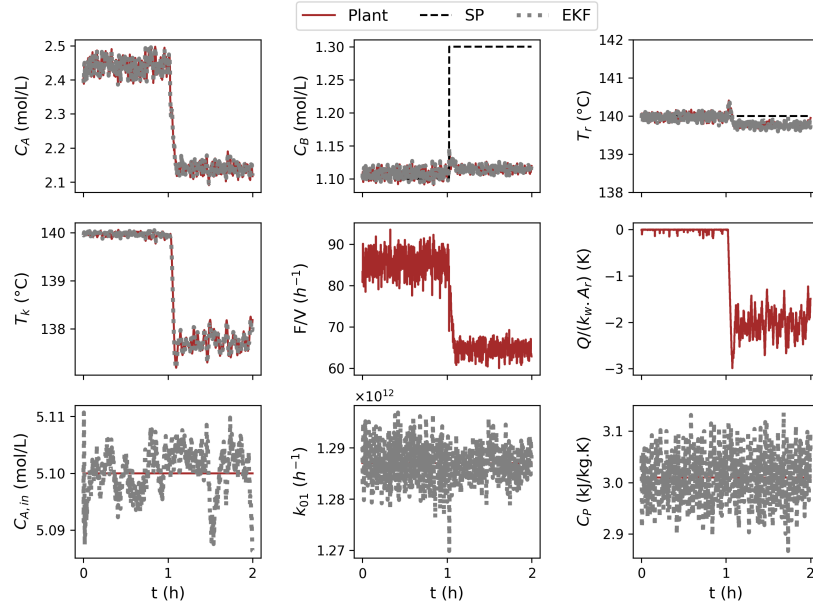
Figure S.38: Simulation for combination 7 and case 2, considering unreachable set-point.
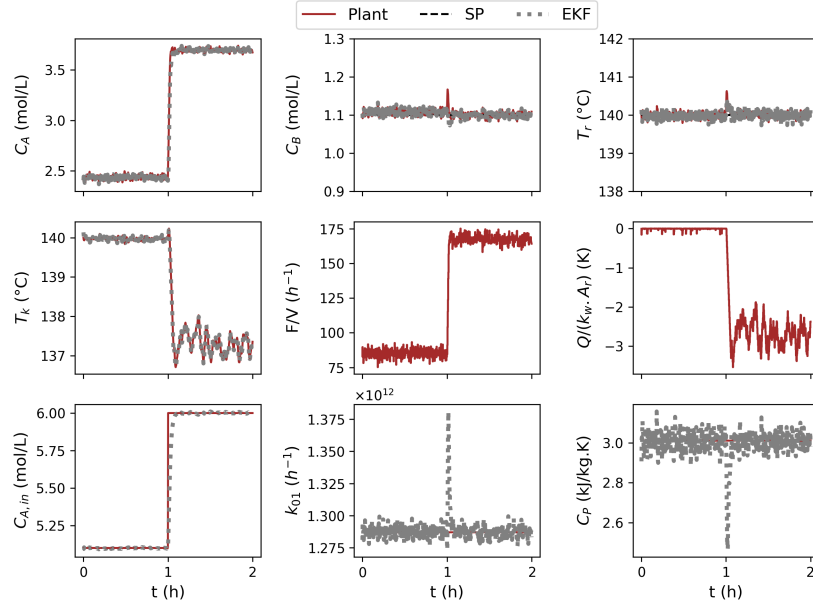

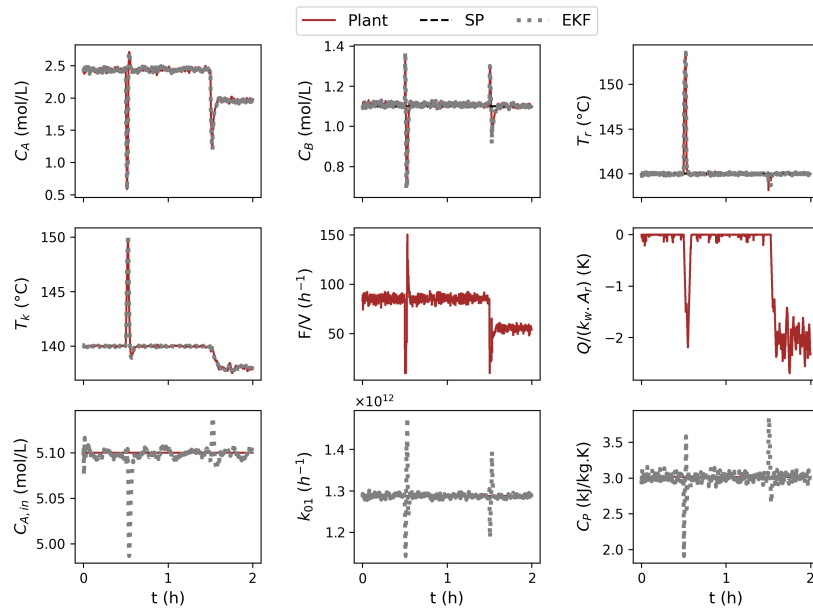Figure S.39: Simulation for combination 7 and case 3, considering a change in $C_{A,in}$.

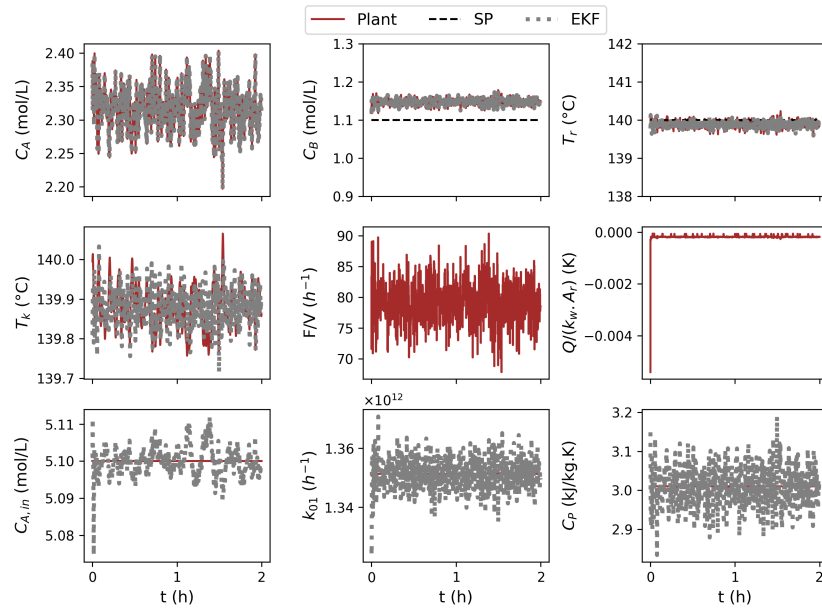Figure S.40: Simulation for combination 7 and case 4, considering changes in T_{in}.

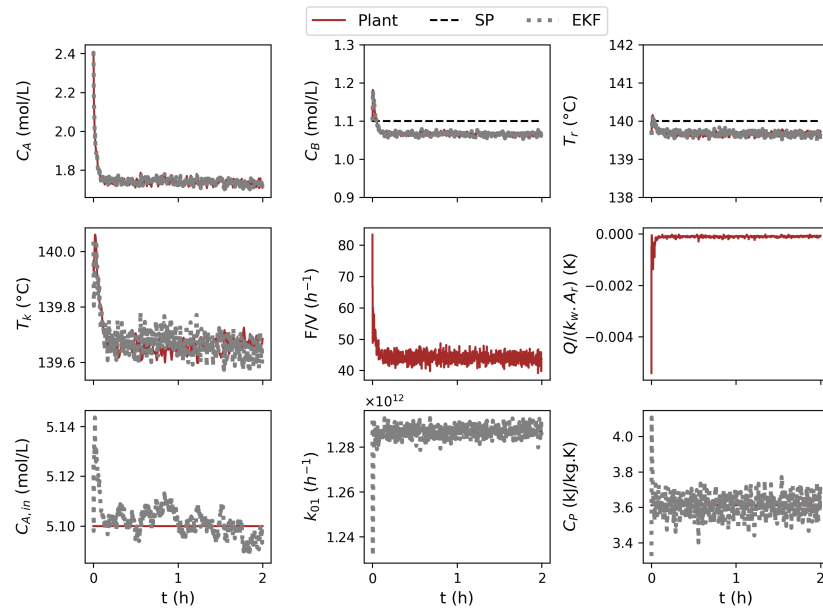Figure S.41: Simulation for combination 7 and case 5, considering mismatch in k_{01}.

Figure S.42: Simulation for combination 7 and case 6, considering mismatch in C_P.
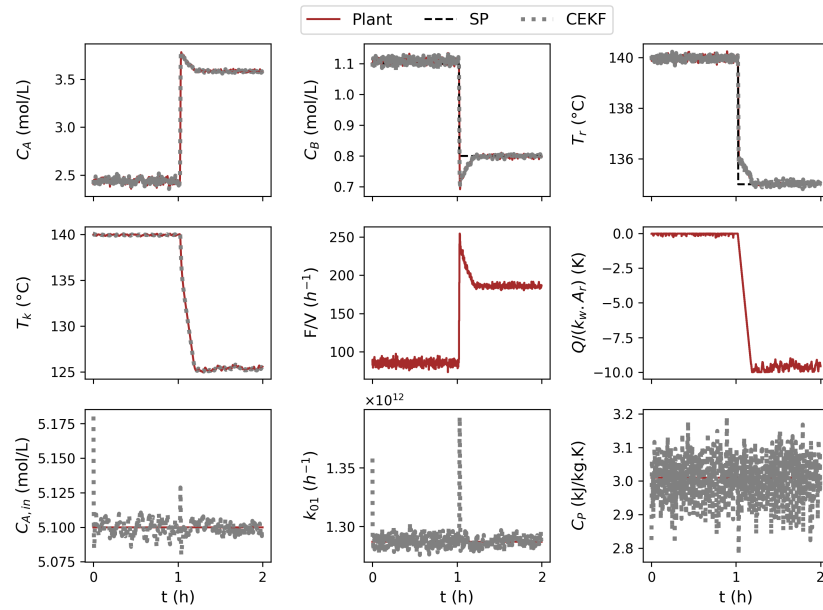
S.I.8   Combination 8: OC and CEKF

Figure S.43: Simulation for combination 8 and case 1, considering set-point changes.
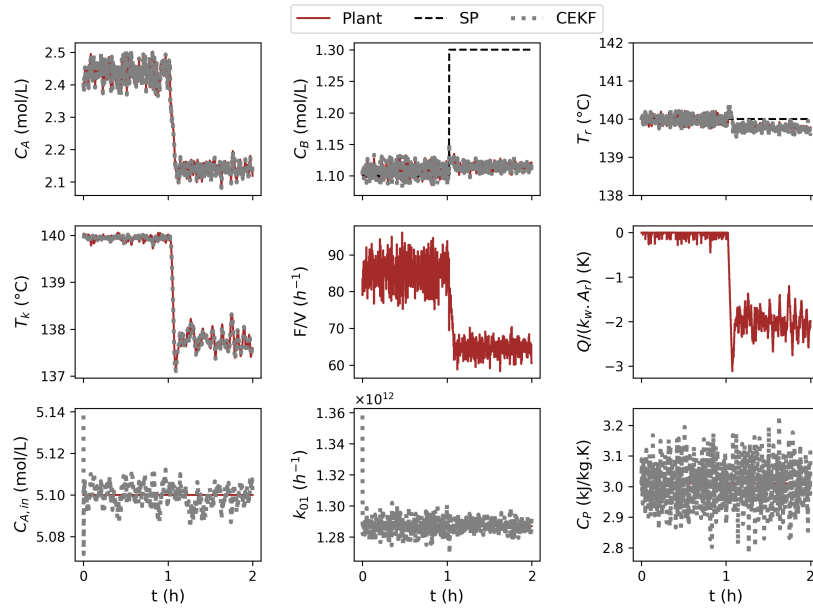
Figure S.44: Simulation for combination 8 and case 2, considering unreachable set-point.
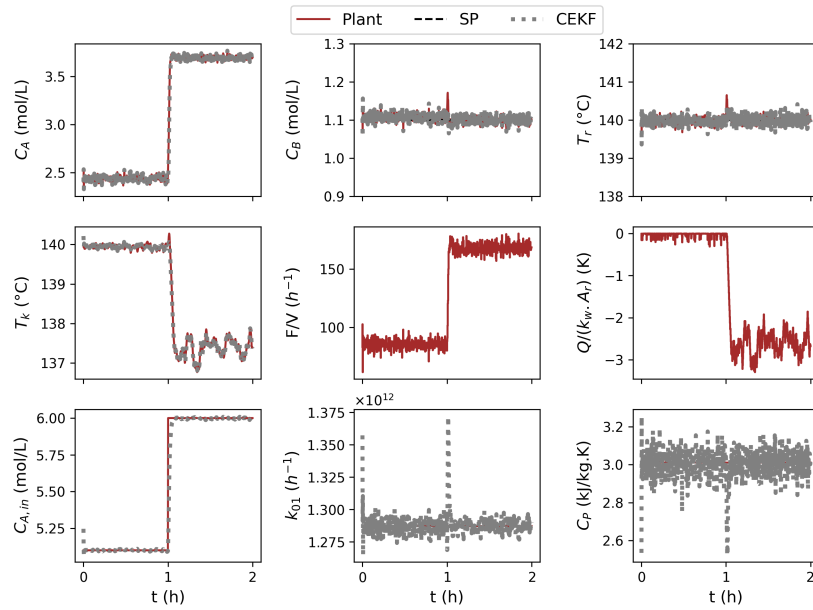

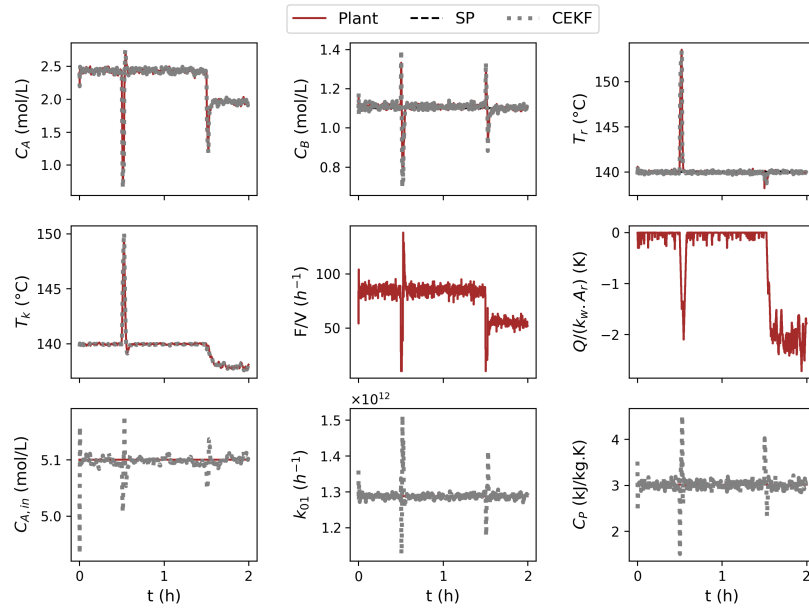Figure S.45: Simulation for combination 8 and case 3, considering a change in $C_{A,in}$.

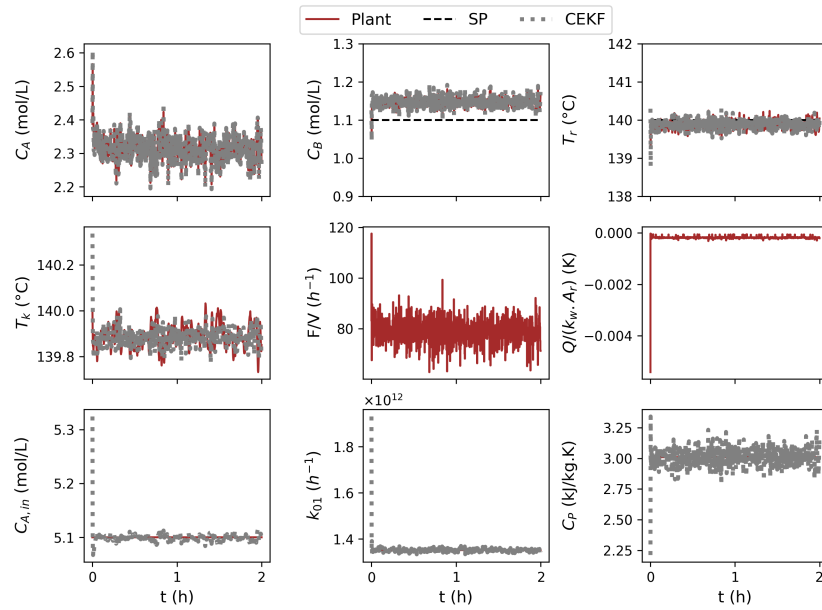Figure S.46: Simulation for combination 8 and case 4, considering changes in T_{in}.

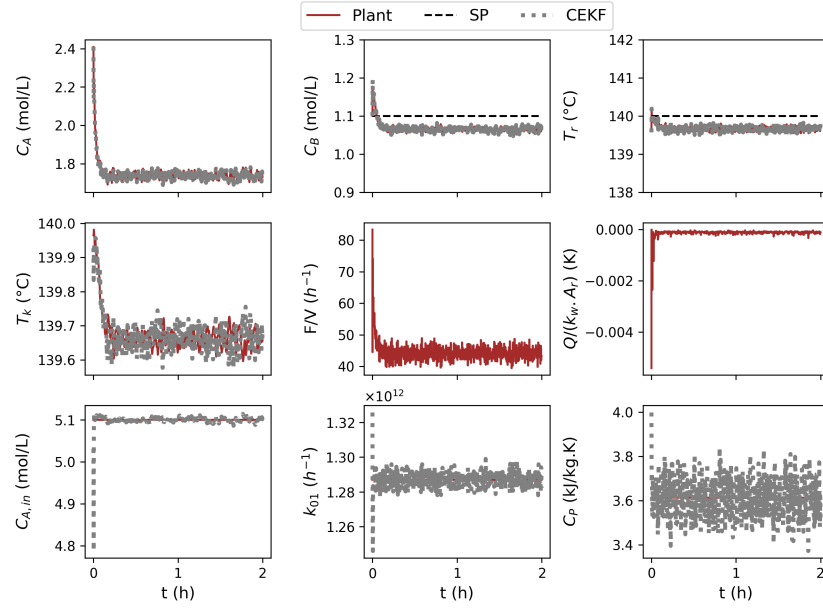Figure S.47: Simulation for combination 8 and case 5, considering mismatch in k_{01}.

Figure S.48: Simulation for combination 8 and case 6, considering mismatch in C_P.
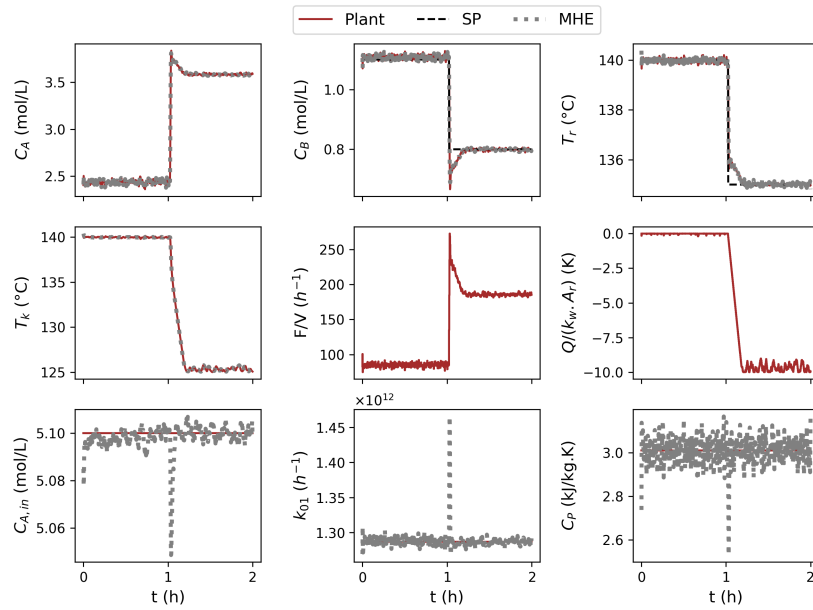
S.I.9   Combination 9: OC and MHE

Figure S.49: Simulation for combination 9 and case 1, considering set-point changes.
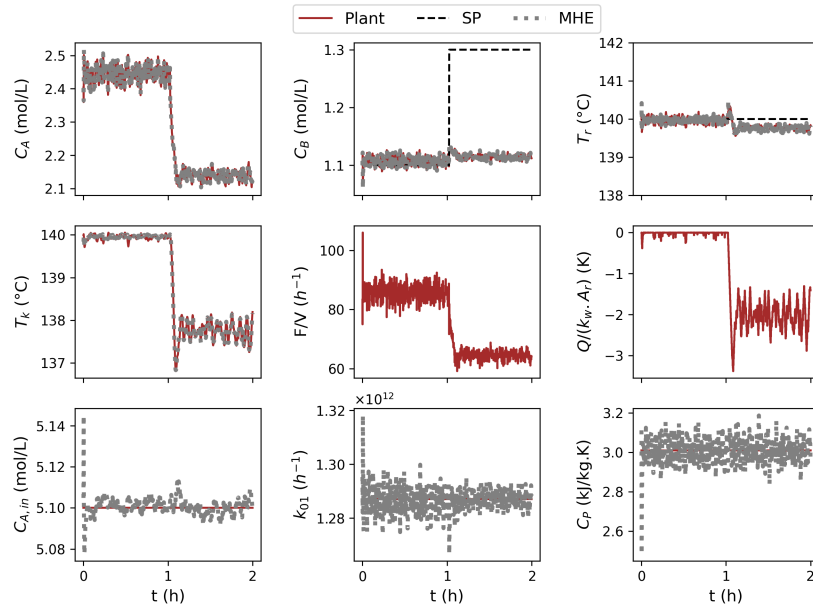
Figure S.50: Simulation for combination 9 and case 2, considering unreachable set-point.
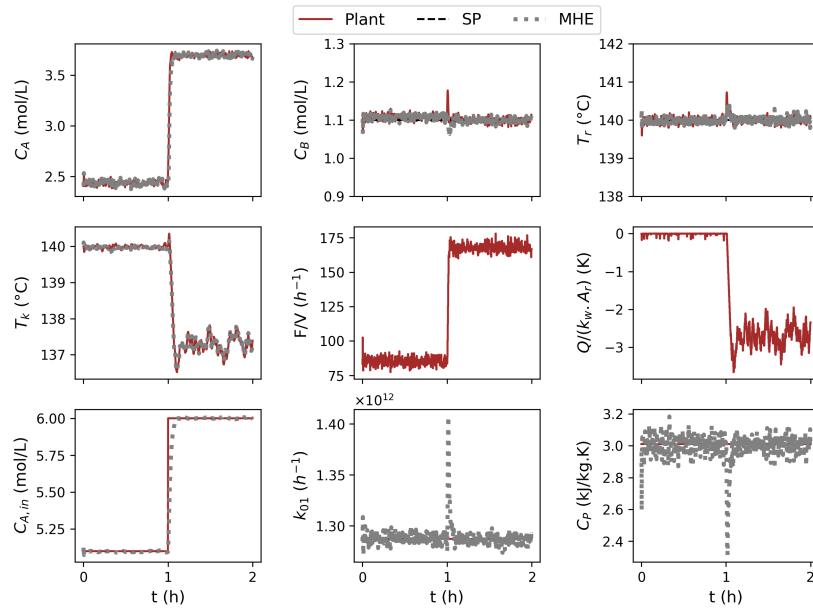

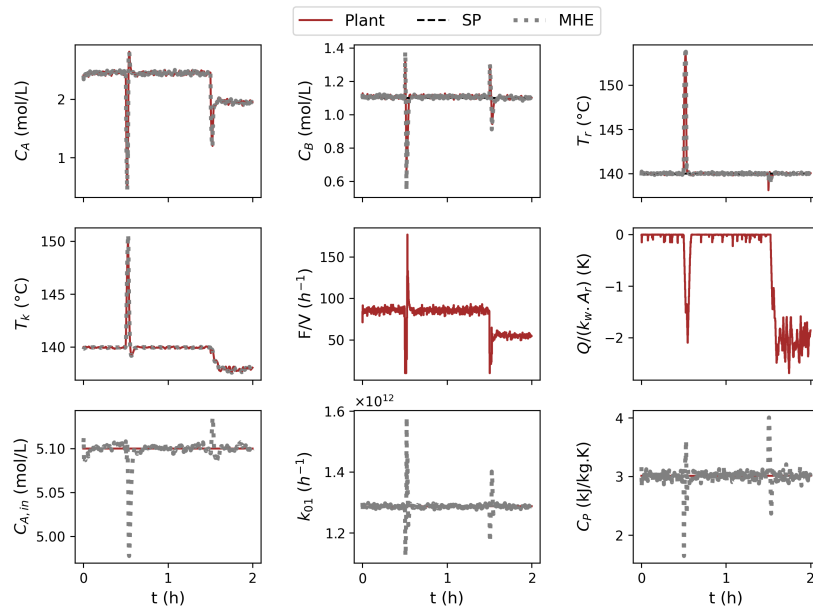Figure S.51: Simulation for combination 9 and case 3, considering a change in $C_{A,in}$.

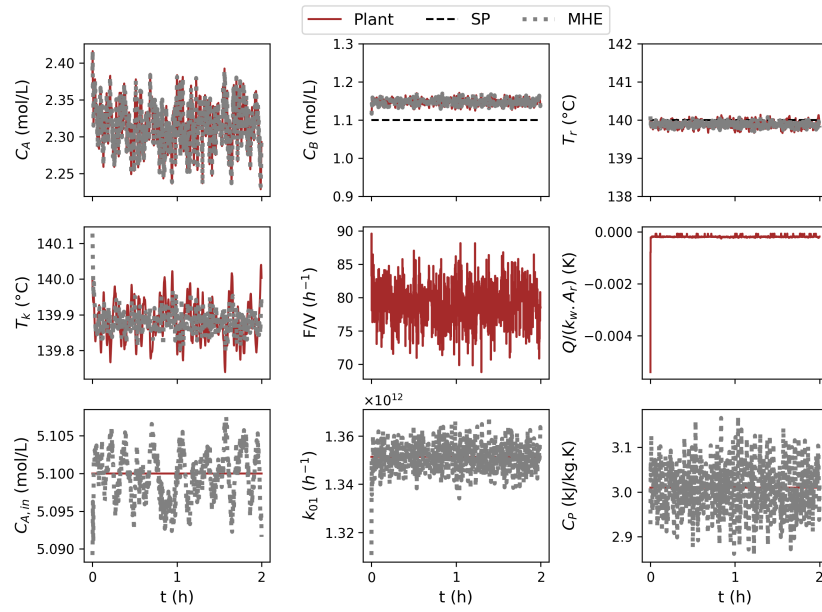Figure S.52: Simulation for combination 9 and case 4, considering changes in T_{in}.

Figure S.53: Simulation for combination 9 and case 5, considering mismatch in k_{01}.
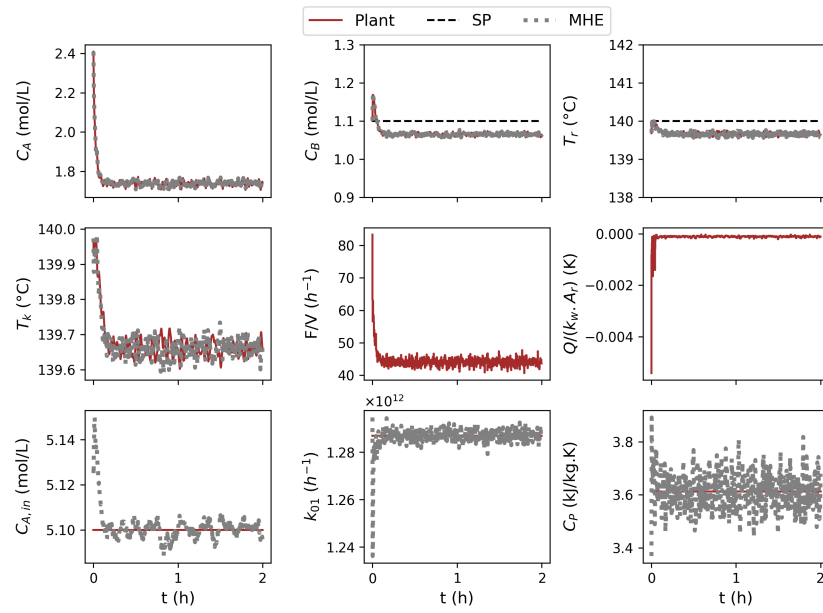
Figure S.54: Simulation for combination 9 and case 6, considering mismatch in C_P.