Production of Succinic Acid from Glucose via Fermentation Pathway

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Background & Description:

A Succinic acid is an important platform chemical used in polymers, pharmaceuticals and food applications. It is commonly obtained through microbial fermentation of carbohydrates, where glucose acts as the main carbon source. The objective of this work is to develop a flowsheet in DWSIM to represent the essential reaction and separation steps required to obtain purified succinic acid from a glucose feed.

In the present simulation, glucose undergoes conversion to succinic acid in a stoichiometric reactor operated under specified temperature and pressure conditions. The two reactor outlets are combined and directed to a vapour–liquid separator, where gaseous by-products such as CO_2 are removed. The liquid fraction is subsequently cooled to promote partial crystallization. The cooled mixture is sent to a compound separator to isolate the solid succinic acid crystals from the mother liquor. The crystal stream is then dried to obtain the final product.

A schematic of the complete flowsheet is shown below, illustrating the reactor, separation units and auxiliary equipment used for modelling the process in DWSIM.

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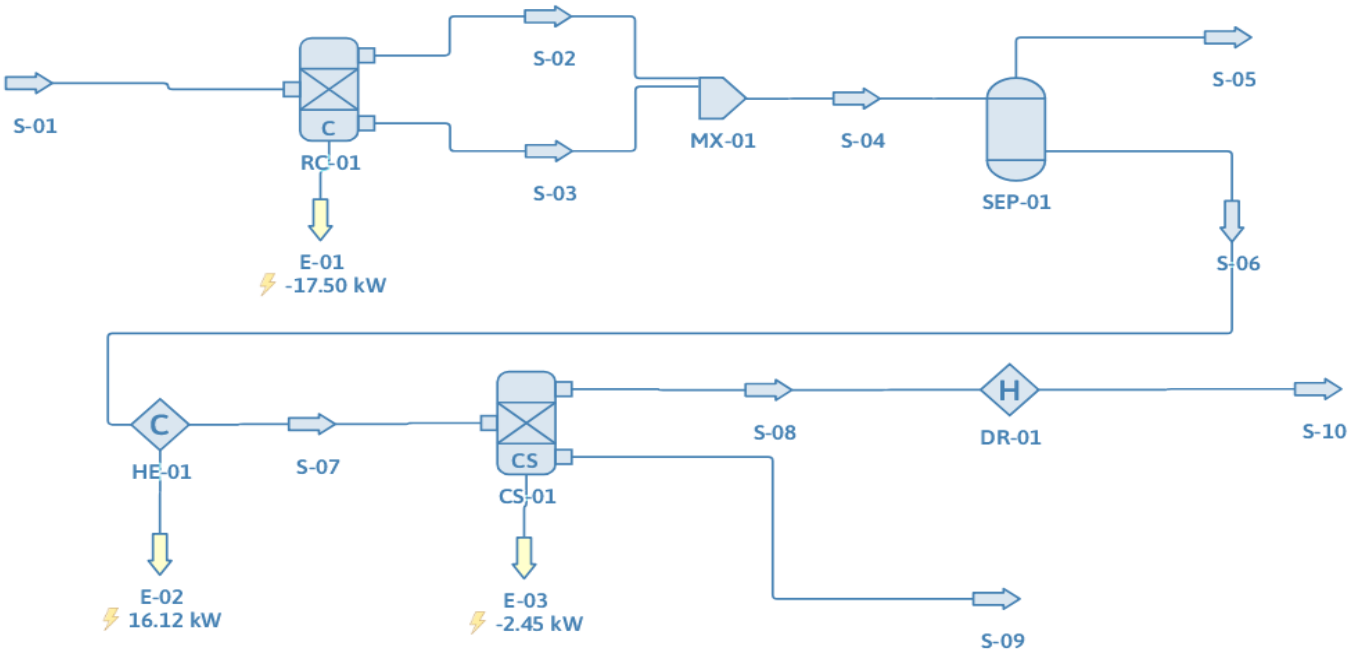

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Results:

Stream-wise results obtained from the simulation are summarized in Table 1. The feed stream (S-01) enters at 30 °C and 1 bar, while the reactor outlet streams (S-02 and S-03) carry the converted mixture. After vapour–liquid separation, the gaseous stream (S-05) contains CO_2 and trace gases, and the liquid stream (S-06) contains dissolved succinic acid and water. Cooling and crystallization produce a solid-rich stream (S-08), which after drying yields the final succinic acid product stream (S-10). Mass and energy balances were checked to ensure consistency across all unit operations.

Master Property Table								
Object	**S-10**	**S-08**	**S-07**	**S-06**	**S-05**	**S-04**	**S-01**	
Temperature	182.89	182.89	15	30.0013	30.0013	30.0013	30	**C**
Pressure	0.99	0.99	0.99	0.99	0.99	0.99	1	**bar**
Mass Flow	31.4624	31.4624	972.382	972.382	27.6192	1000	1000	**kg/h**
Molar Flow	0.266432	0.266432	49.9053	49.9053	2.27259	52.1778	50.5127	**kmol/h**
Volumetric Flow	0.0259464	0	0.97538	0.977789	57.8569	58.8346	1.00478	**m3/h**
Molar Fraction (Overall Liquid)	1	0.774565	0.999998	1	0	0.956445	1	
Mass Fraction (Overall Liquid)	1	0.774565	0.999999	1	0	0.972381	1	

Table 1: Streamwise Results for the Succinic Acid Production Flowsheet