Team 6
Solving Paraformaldehyde Issue in Formalin Production

1- Abdulrahman Al-Subaie | CHE   2- Omar Aldossary | CHE   3- Meshari Almutairi | ME   4- Osama Otaif | ICS

Problem Statement

Formalin is a vital raw material, but paraformaldehyde formation poses a significant challenge. Existing solutions are insufficient, and our proposed approach effectively eliminates this issue.

Specifications

1- Produce 21,000 kg/h of 39% wt formalin.
2- Maintain methanol concentration below 1.5% wt.
3- Ensure remote data accessibility via a website.

Constraints

1- Total process energy consumption must be under 17,434.5 kW.
2- Output formalin temperature must not exceed 52°C.
3- Website load time must be under 3 seconds.
4- Data access must require no more than 4 clicks.

Prototype Design

Reactor Sizing			
Cross-Sectional Area	Diameter	Height	Volume
4.511 m²	2.397 m	10 m	45.11 m³

Mass	
Catalyst	ceramic raschig rings
17387.12 kg	10112.81 kg
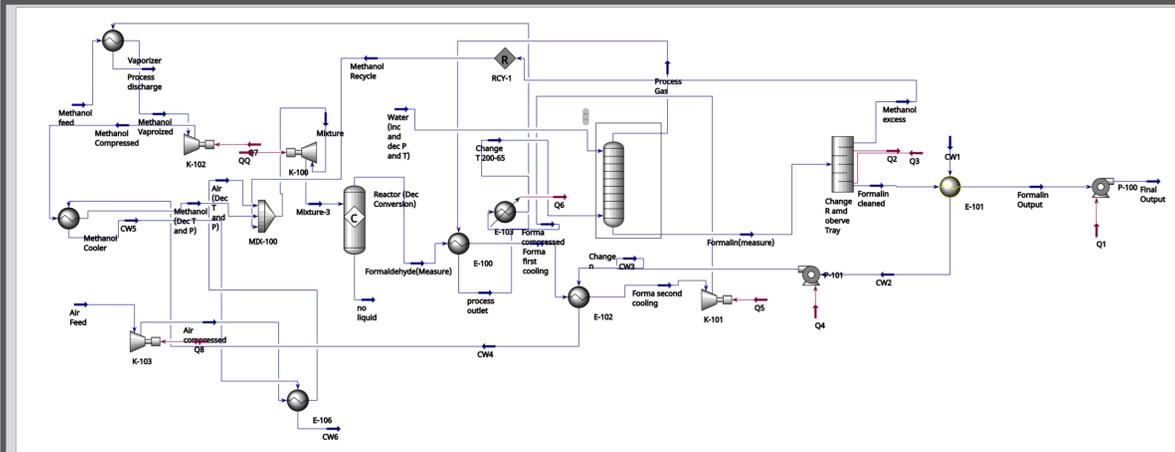
Heat Exchanger Sizing			
Name	Number of Tubes	Tubes volume	Shell volume
Methanol Vaporizer	614	2.127 m²	3.848 m²
Methanol Cooler	76	0.1055 m²	0.346 m²
Air Cooler	125	0.1736 m²	0.346 m²
Formaldehyde Cooler 1	776	2.688 m²	3.848 m²
Formaldehyde Cooler 2	376	1.302 m²	2.463 m²
Formalin Cooler	1028	3.561 m²	5.542 m²

Columns Sizing				
Name	Number of Trays	Space Between Trays	Height	Volume
Absorption	32	0.6 m	20.4 m	65.506 m³
Distillation	10	0.6 m	7.2 m	7.675 m³
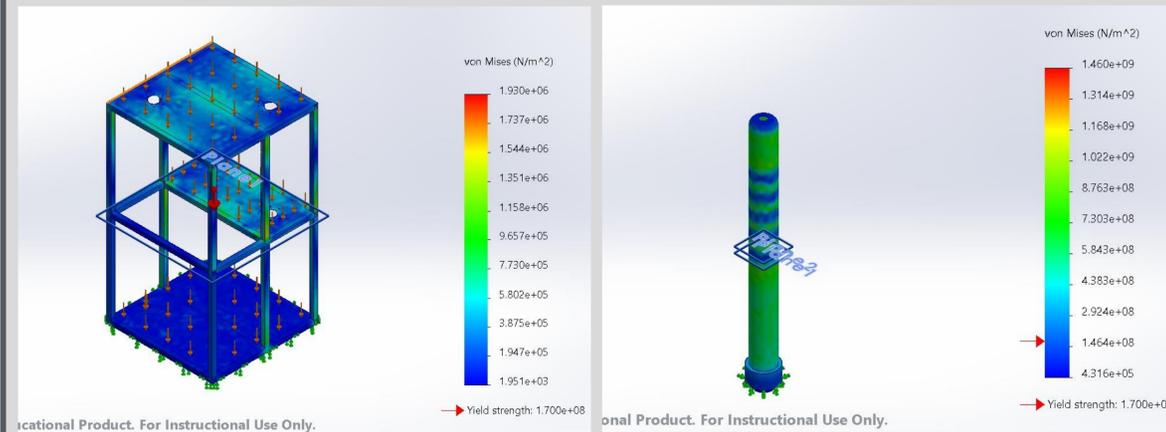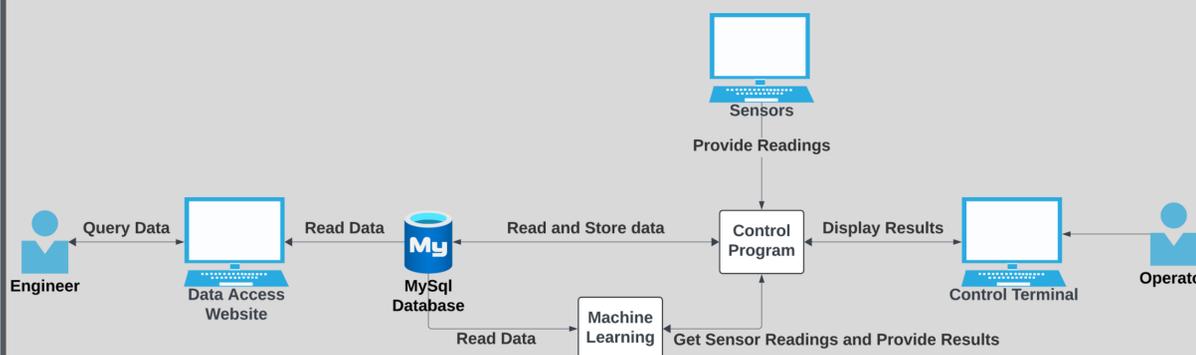
Validation

The Aspen Hysys simulation met specifications 1 and 2 and constraint 2, while the working prototype satisfied specification 2, producing 25,060 kg/h of 39% wt formalin at 52.01°C with 1.53% wt methanol.

Before Distillation

After Distillation
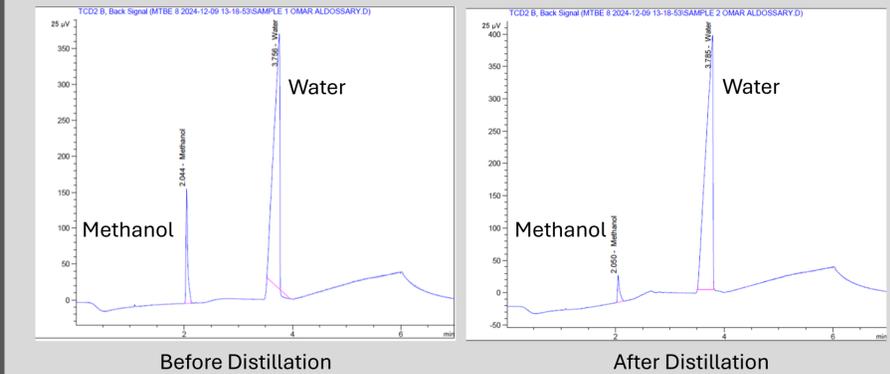
Specification 3 and constraints 3 and 4 were achieved through the website team6.team.

Conclusion

Our project tackles paraformaldehyde formation in formalin production with innovative designs, including methanol inhibition and AI-driven optimization, enhancing efficiency, sustainability, and reliability in chemical processes.

More Information