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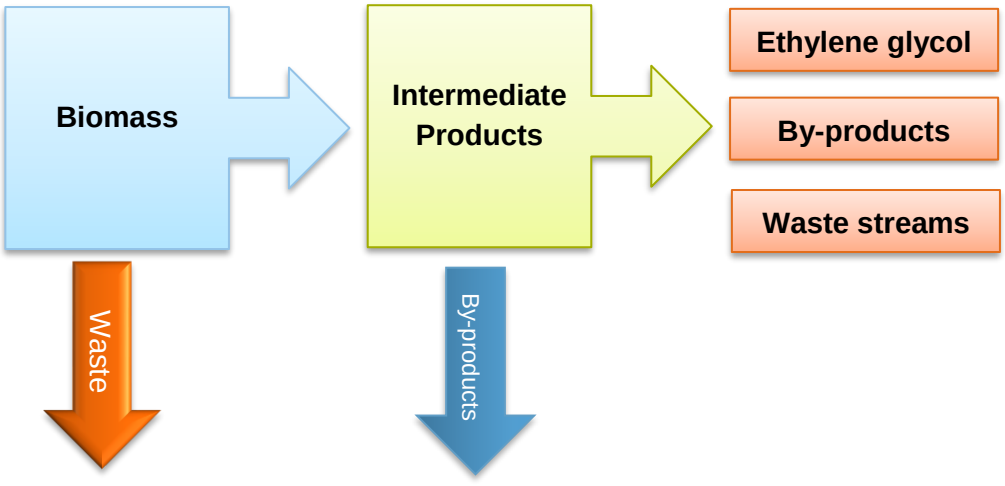
# Design of a Biomass to Ethylene Glycol Plant

**Motivation/background:**
Ethylene glycol is a widely used bulk chemical for various products, such as surfactants, antifreeze agents and PET. Conventional oil and coal-based ethylene glycol routes have high emission of pollutants and a high global warming potential. Due to this fact, the production of ethylene glycol from biomass is a significant replacement for the state-of-the-art process.

**Tasks:**
A general project management, including the definition of work packages, time planning with a Gantt chart and status reports have to be done over the project lifetime.

Your overall task is to design an ethylene glycol plant, which uses no fossil fuels at all. The required data of the product is given in the table below. The first step would be the analysis of different production processes (gasification, fermentation, catalytic) and to pick a suitable one. The main product should be ethylene glycol, side products e.g. propylene glycol, methanol are possible. After selecting a process, the single steps of production have to be analyzed. Overall mass and energy balances need to be calculated. The dimension of the reactors and necessary equipment have to be defined. The basic engineering of the plant should contain all needed apparatus and a P&I with all mass flows. For the main reactor and the distillation column a detail engineering (pipes, wall thickness, instrumentation and control) is required. Based on this data, a calculation for the investment cost and the production cost of ethylene glycol is to be made. A comparison of ethylene glycol produced from biomass to ethylene glycol produced from fossil fuel should be put together.

| Product | |
|---|---|
| Ethylene glycol | 10.000 to/a |
| Purity | 99,5% |



**Structure of the work:**

1. Title page with title, course of study, group members, matriculation number, start date, submission date, supervisor, professorship
2. Summary/Management Summary
3. Table of Contents
4. Tasks and objectives
5. Group structure, division of tasks, procedure
6. Timetable for the preparation of the work
7. state of the art
8. Description of the plant or apparatus to be planned, plant design
9. Plant diagram/process flow diagram of the plant according to DIN EN ISO 10628 with designation of the essential apparatus, machines and media.
10. Description of the system function
11. Brief description of the plant group, apparatus, machine within the plant
12. Prepared mass and energy balance for the plant and/or apparatus and machinery according to the task, using the necessary chemical, biological, reaction, thermodynamic, fluidic, thermal and material transport aspects.
13. Execution of experiments, analysis, results (optional if required)
14. Technical design and scale-up of the apparatus or machines according to the technical requirements such as turnover, volume/dwell time, pressure, temperature, pH value, ...
15. Technical design according to safety aspects such as material selection, corrosion, wall thickness according to e.g. AD 2000, gasket selection for flanges, bearing types of agitator shafts, insulation requirements, requirements for explosion protection zones, air exchange, ...
16. Technical design according to licensing aspects such as pollutant emissions in exhaust gases and exhaust air, noise emission, waste water pollution, ...
17. Overview of the prepared safety concept (HAZOP) with treatment of the essential safety aspects (Machinery Directive, pressure, explosion, machine) and solutions (according to product safety), indication of the method of safety assessment
18. Prepared technical equipment specifications with regard to technical design parameters, material specifications and other, e.g. production-related, special features and requirements such as welds and tests.
19. Derivation and presentation of a control concept with essential system-technical and safety-technical control loops in a piping and instrument flow diagram
20. Prepared media specifications of essential input materials, products and wastes with reference to the plant diagram, properties and safety
21. Capex and Opex calculation and economic evaluation by means of an economic efficiency calculation according to VDI 2067 or cash flow consideration.
22. Bibliography with reference to the most important literature, literature references in the chapters
23. Appendix with list of figures and tables, ...