# Municipal Solid Waste Project

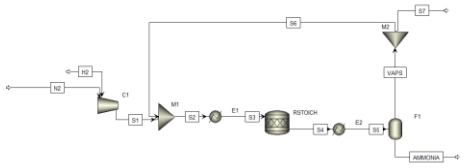
**University of Oklahoma- CBME- CHE 4253 (Fall 2018)**

## Part 5- Ammonia Production Section Studies

The overall objective of the study is to determine the feasibility of changing the processing of municipal solid waste in the city of Norman, or in the area if that is more convenient, from the current combination of recycling and landfilling to the production of chemicals.

## This Task Statement

We focus on the ammonia plant. We assume that the ammonia reactor will operate rendering equilibrium compositions facilitated by a catalyst. Feed stream's pressure are atmospheric and the temperature are room temperature (60 F). $N_2$ has 0.625 mol% Ar, and $H_2$ has 1.2 mol% Methane. The $H_2$ flowrate is the value selected by you for the OKC area. Your product is ammonia 97%+, delivered at P≥ 240 bar.




Commented [BMJ1]: Kayla: Add a compressor. Use two feed streams, one with N2 and Argon, and the other with H2 and CH4.

1) Reaction Temperature and Pressure: Determine ammonia yield as a function of temperature, pressure and excess of one of the reactants in a single equilibrium reaction (no need of the flowsheet here, just the reaction). Plots should be revealing. You determine which reactant is in excess and how much would be recommended.
2) Reactor: Consider two types of reactors, isothermal or adiabatic. Simulate both reactors separately without the recycle and with the recommended excess of reactant obtained in step 1. Which type of reactor will would you use and why? Your answer should use the info from 1)
3) Recycle and purge: Discuss why you need a recycle. Discuss why you need a purge. Discuss what is the effect on the reactor and the overall economics of a larger or a smaller purge.
4) Anything you would do with the purge other than throwing it away?
5) Operating Costs I: Assume that the pressure drop in the recycle is 2 bar, the pressure drop in the rest of the equipment and their associated piping is 15 psi per equipment. Identify clearly where a compressor (if any) should be inserted and obtain the Cost of Power for one choice of purge.
6) Operating Costs II: The preliminary flowsheet has a heater and a cooler with target temperatures that you will decide. Make sure you show how the flowsheet will be heat integrated and what are the utilities that are needed. If the reactor needs cooling, what is the coolant you will use? Obtain the Cost of heating/cooling utilities for one choice of purge as well as reactor inlet temperature.
7) Optimize the flowsheet: Obtain the best reactor type, best inlet temperature to the reactor, and best pressure of the system so the total annualized cost is minimum (TCI=FCI/n+OC). Make sure that power and utilities are counted in the Operating Costs (OC).
8) Increased delivery composition: Discuss ways of increasing the composition of the delivered $HH_3$.

**Grading Rubric:** 1): 10%, 2) 5%, 3) 10%, 4) 10%, 5) 10%, 6) 10%, 7) 35%, 8) 10%.

**THIS TASK IS INDIVIDUAL AND THERE IS NO DISCUSSION WITH OTHER STUDENTS ALLOWED, ONLY WITH THE TA AND THE PROFESSOR.**