

# PROCESS SIMULATION CUP 2016

## REAL-LIFE SIMULATION TRAINING FOR PROCESS ENGINEERING STUDENTS

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Generating biogas from agricultural waste, sewage or food waste is a cornerstone of many modern farms. Depending on how the biogas is going to be utilised, it often needs some form of cleaning to reduce the amount of unwanted impurities. These impurities can affect the equipment for biogas utilisation, by causing corrosion and mechanical wear, but may also lead to unwanted emissions.

### CHALLENGES IN ENGINEERING COURSES

- Lack of real-life industry data
- Reliance on textbook problems
- Need for innovative teaching methods
- Student's readiness to enter the industry
- Technology of commercial simulators

### WHY TEACH WITH SIMULATIONS

- Theory meets practice
- Replication of complex real world aspects
- Hands-on teaching method
- Industry focused skills development
- Enhance student's technical knowledge

### PSC AS A UNIQUE PROCESS SIMULATION TEACHING TOOL

PSC tasks emulate the modern demands and challenges relevant to engineering professionals. Students apply knowledge gained in the classroom in a real-work environment. PSC benefits:

#### TEACHERS

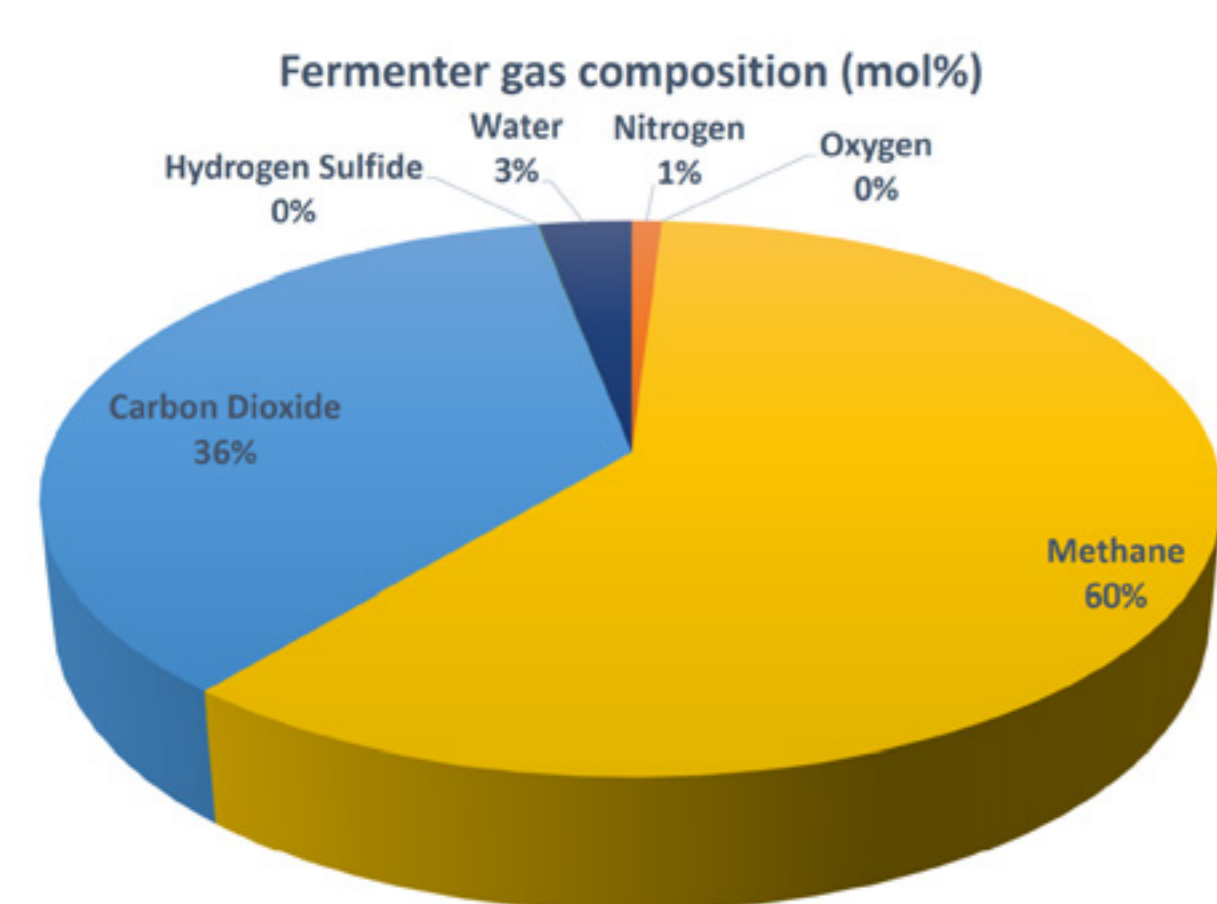
- Real industry data simulation training
- Practical student/class assessment tool
- Motivating and challenging teaching tool
- Active teaching method
- Increased learning outcome for students

#### STUDENTS

- Critical and problem solving skills test
- Understanding of the essence of the simulated phenomenon
- Technical software knowledge
- Industry relevant skills acquisition

### CHALLENGE BACKGROUND

Agricultural waste has a lot of bound chemical energy in the form of cellulose and other complex hydrocarbon molecules. Hydrocarbons from agricultural waste can be transformed to methane, carbon dioxide and water by microorganisms in a fermentation process. In order to feed it to the natural gas net and thus store it as renewable energy source, the components CO<sub>2</sub>, H<sub>2</sub>S and NH<sub>3</sub> must be removed or reduced. For this, the pressurized water process is a good alternative to other scrubbing processes, since it doesn't involve the use of any additional chemicals other than water. Such a process is used for cleaning the fermenter gas.



#### FERMENTER GAS

Flow rate 300 Nm<sup>3</sup>/h  
Temperature 50 °C  
Pressure 1 bar abs.

#### PRODUCT GAS

CH<sub>4</sub> > 96 mol%  
H<sub>2</sub>S < 20 ppm

### TASK

Students are asked to maximize the exergetic efficiency of a Pressurized Water Process for bio gas cleaning.



### HOW TO JOIN PSC

REGISTER ONLINE

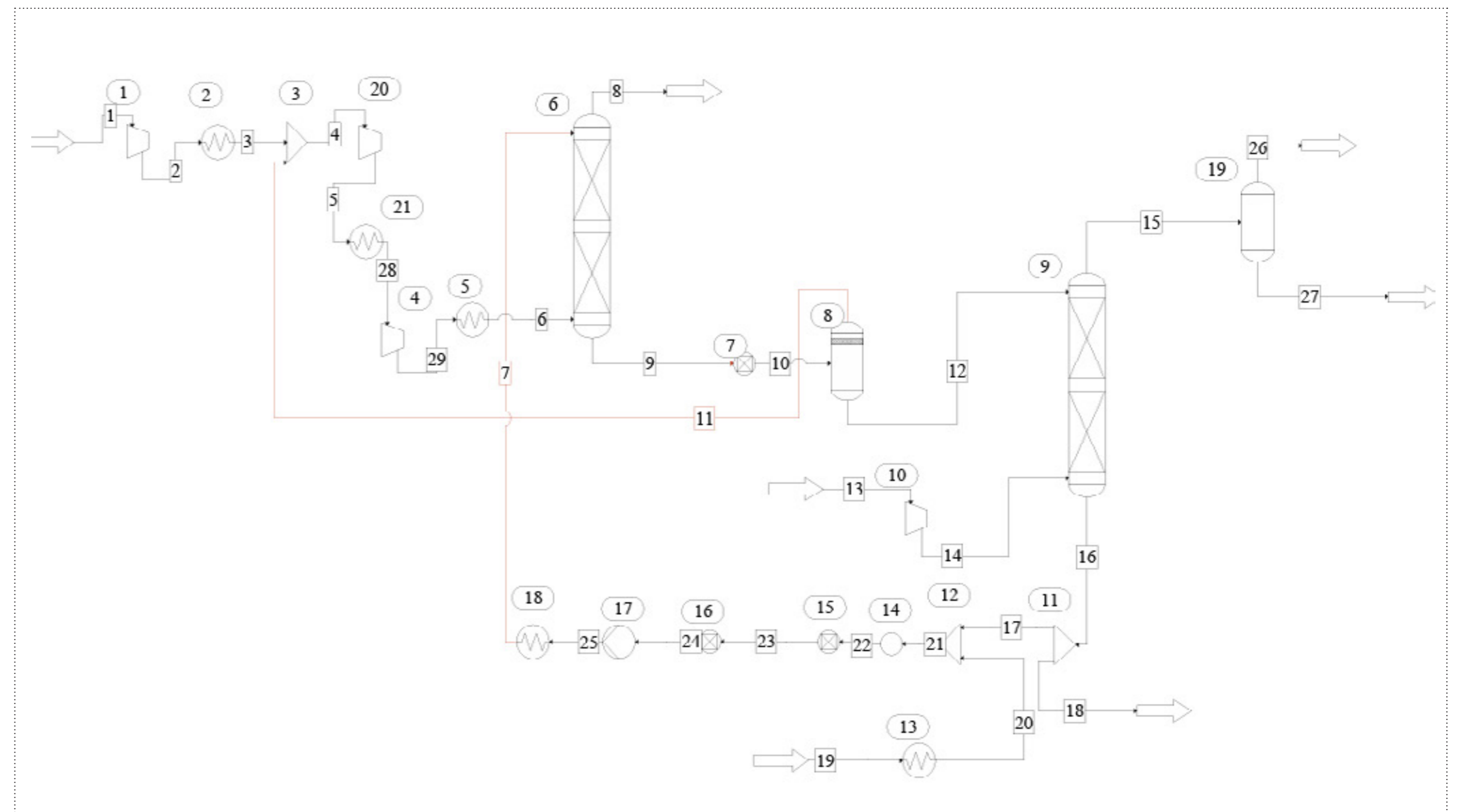
DOWNLOAD CHEMCAD & FLOWSHEET

CRUNCH NUMBERS

SUBMIT VARIABLES

CHECK HIGHSORE TABLE FOR RESULTS

### FLOWSHEET OF THE PRESSURIZED WATER PROCESS



### EXERGY ANALYSIS

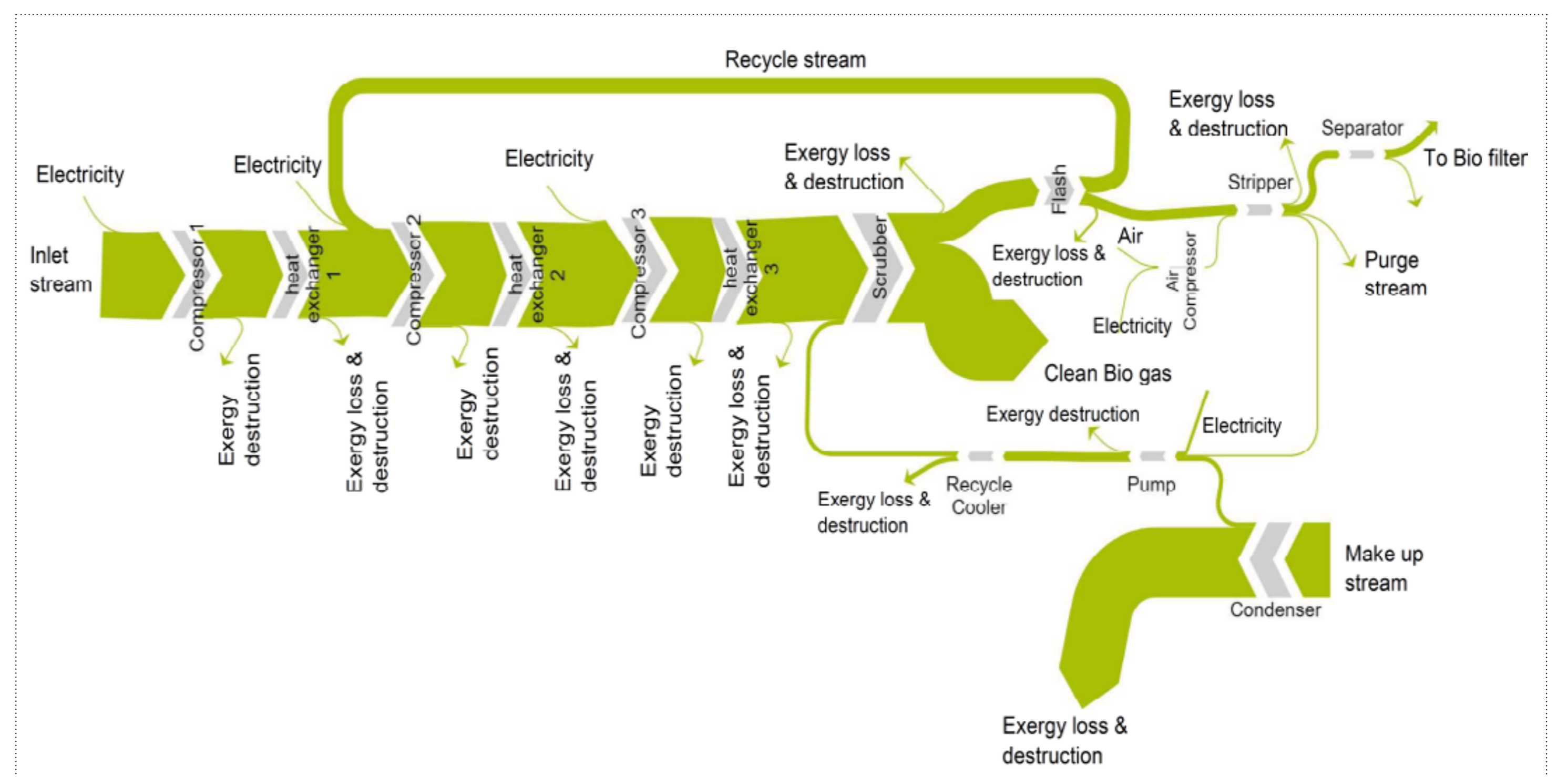
Exergy is defined as the utilizable part of a material streams energy content. Thus, electricity is 100% exergy! For the exergy analysis of the Pressurized Water Process physical and chemical exergy of the material streams are considered.

- Exergetic efficiency ( $\Psi$ ) of the process: Ratio of the exergy of the product stream to that fed to the process in form of material streams and electricity.

$$\psi = \frac{E_{prod}}{E_{in}}$$

- This efficiency can be improved by minimizing the consumption of cooling water, consumption of make up steam and consumption of electricity, while maximizing the exergy of the output stream.

### EXERGY FLOW DIAGRAM FOR THE PRESSURIZED WATER PROCESS



### SUMMARY

This task introduces the concept of exergy analysis and its use in the process industry. Such an optimization problem is common in industries and gives the student a deeper understanding of the overall process. It is in the interest of academia to arrange teaching methods and assessments which reflect aspects of the real world problems in an interactive fashion as it is done in the case of PSC.

### PSC FEATURES

- Open to bachelor, masters, Ph.D. students
- Open to CHEMCAD users and non-users
- Tasks developed with real industry data
- Fully automated online contest
- Worldwide entry all year long
- Unlimited number of participants
- Unlimited number of submissions
- Calculations displayed in real-time
- Full process description and flowsheets provided

### PSC AWARDS

- Professional CHEMCAD Training
- Certificates & Vouchers
- Recognition on PSC website

