Distillation Of Aqueous Acetone

Background:

Acetone is used across industries for many purposes, including:

- Automotive and furniture finishing
- Degreasing and degumming agents
- Paint varnish, lacquer strippers
- General purpose cements
- Various other uses

The main purpose of acetone being a solvent in various processes it is economically viable to recycle the used acetone rather than using fresh acetone in a given industry. Hence simple distillation can be carried out especially if it's a mixture of acetone and higher boiling components like water. Acetone boils at about 43 degrees lower temperature as compared to water and we can obtain high purity acetone by using simple distillation techniques.

Description of flowsheet:

The feed enters at 10000kg/h with a mass fraction of 0.25 at 26.7 degree Celsius in to a preheater heat exchanger where it is heated up to 38 degree Celsius by the bottoms of the distillation column. The preheated feed then enters the 3rd stage of the 10 staged distillation column which is operation with 1 atm condenser and boiler pressure at a reflux ratio of 9.16. The distillate obtained has 0.95 mole fraction of acetone at 2386.13kg/h and the bottoms is obtained at 7614kg/h at 96 degree Celsius temperature which is recycled to a heat exchanger and used to preheat the feed. Also the distillate obtained is cooled in a heat exchanger with cooling water at 26.7 degree Celsius where the heat exchanger is designed to give purified acetone at 38 degree Celsius temperature as the final product. The Roult's Law property package is used in the flowsheet.

Results:

1) Purified acetone at mole fraction of 0.950014 is obtained.
2) 582.73kW of net energy is required in the process where condenser gives 3674.57 kW energy output and the reboiler requires 4257.3kW of energy as calculated in the flowsheet.

3) The distillate obtained is at a high temperature and is cooled to the required temperature of 38degree Celsius to obtain the required product.

Conclusions:

1) The distillate concentration can be varied by varying the reflux ratio in the distillation column. By increasing the reflux ratio, higher purity of acetone can be obtained.
2) The distillate obtained is at a temperature much higher than room temperature and hence the acetone will be highly volatile and hence requires cooling.
3) The bottoms is at 96 degree Celsius and hence this heat can be effectively used to preheat the feed or elsewhere.
4) Hence acetone can be effectively recycled and used in various industries which makes this process economically viable.

Reference:

Mass Transfer Operations, by Robert E. Treybal, Chapter 9, Problem no.10