

Practice Exercises for Mass Integration and Pollution Prevention

1. Consider the VAM process described in the lecture. A new reaction pathway has been developed and will to be used for the production of VAM. This new reaction does not involve acetic acid. The rest of the process remains virtually unchanged and the AA losses with the product are 100 kh/hr. What are the targets for minimum fresh usage and discharge/losses of AA?
2. Consider the food processing plant shown in the simplified flowsheet of Fig. 1. The primary feedstocks are first pre-washed then processed throughout the facility. The gaseous waste of the process is cleaned in a water scrubber prior to discharge. Therefore, the process has two sinks that consume fresh water: the washer and the scrubber. Table 1 provides the data for these two sinks. The process results in two aqueous streams that are sent to biotreatment but may be considered for recycle: condensate I from the evaporator and condensate II from the stripper. The data for the two process sources are given in Table 2.

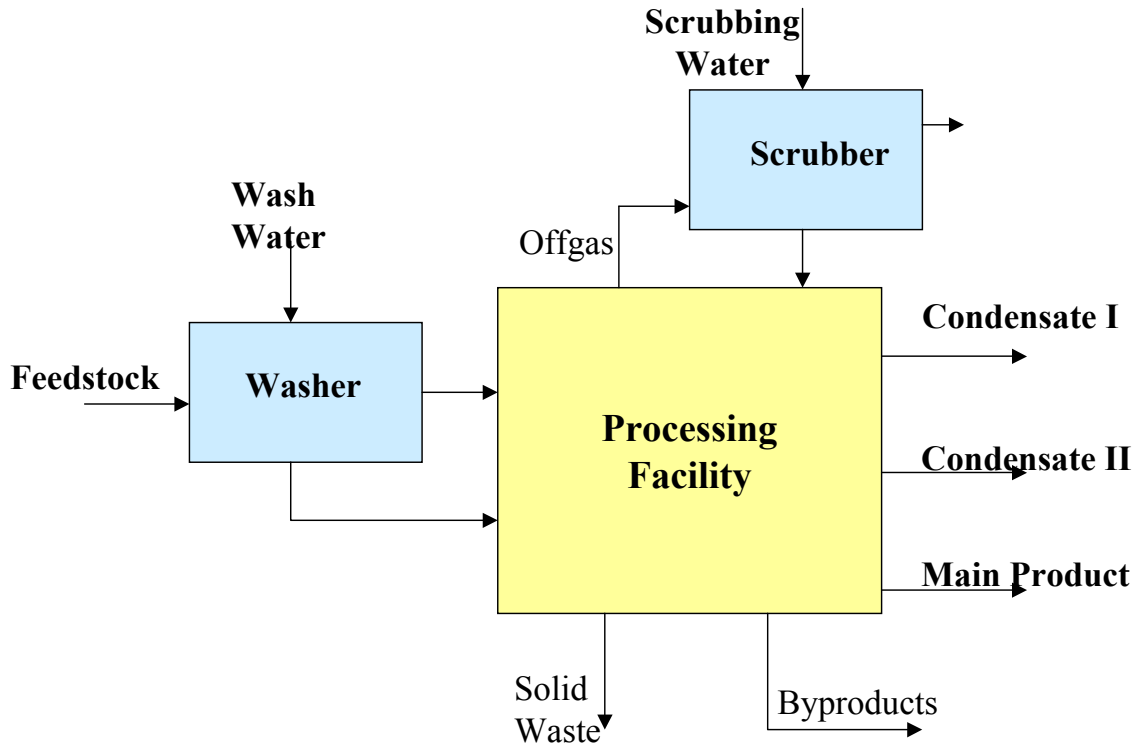


Fig. 1. A Simplified Flowsheet of the Food Processing Plant

Table 1. Sink Data for the Food Processing Example

Sink	Flowrate kg/hr	Maximum Inlet Mass Fraction	Maximum Inlet Load, kg/hr
Washer	8,000	0.03	240
Scrubber	10,000	0.05	500

Table 2. Source Data for the Food Processing Example

Source	Flowrate kg/hr	Maximum Inlet Mass Fraction	Maximum Inlet Load, kg/hr
Condensate I	10,000	0.02	200
Condensate II	9,000	0.09	810

At present, the plant uses fresh water for the washer and the scrubber. In order to reduce the usage of fresh water and discharge of wastewater (condensate), the plant has decided to adopt direct-recycle strategies. An engineer has proposed that Condensate I be recycled to the scrubber (Fig. 2). The result of this project is to eliminate the need for fresh water in the scrubber, reduce overall fresh water consumption to 8,000 kg/hr, and reduce wastewater discharge (Condensate II) to 9,000 kg/hr. Critique this proposed project (compare it with the minimum water-using solution, describe the differences, discuss why an integrated approach yields insights unseen by localized approaches, etc.).

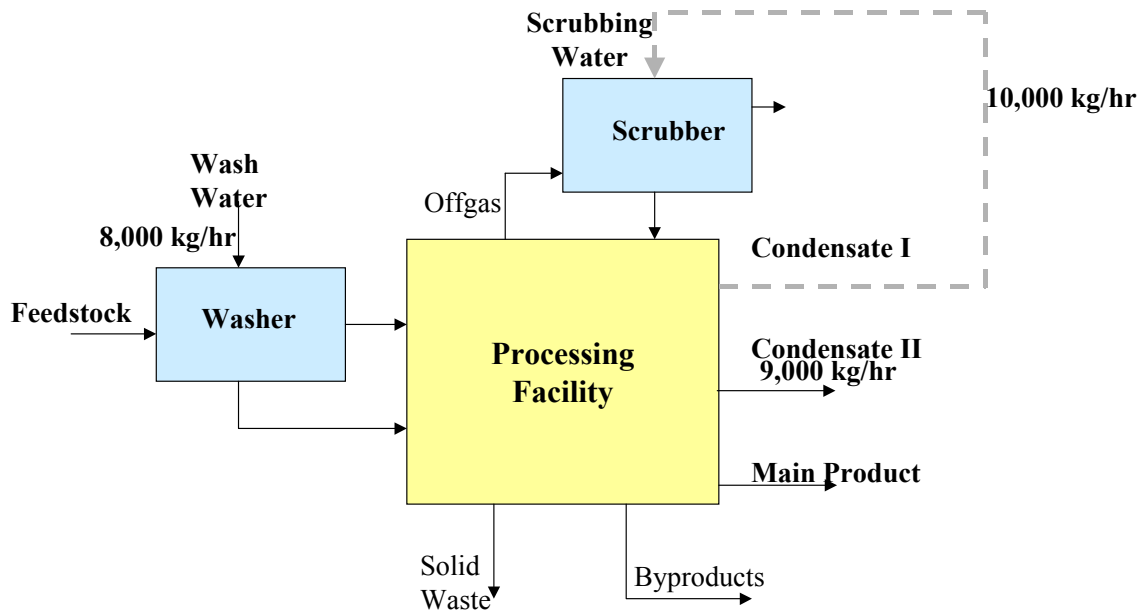


Fig. 2. Proposed Recycle Project