Puu-23.4020 Modelling and simulation of pulp washing and chemical cycle
Examination 25.10.2012

1. The effective alkali of white liquor is EA = 116.0 gNaOH/l. The sulfidity is 39%, causticizing degree is 81% and reduction degree is 94%. Calculate active alkali AA concentration (use unit gNaOH/l). Calculate NaOH, Na_2S, Na_2SO_4 and Na_2CO_3 concentrations (use unit gNaOH/l).

2. The feed consistency to a wash press is 4% and the discharge consistency is 30%. The dilution factor DF = 3.0 t/BDt and the displacement ratio DR = 0.50. What is the E-value of the wash press? What is the E_{10}-value of the wash press?

3. The feed consistency of the unwashed pulp to a washer is 10% and the discharge consistency of the washer is 12%. The dilution factor of the washer is 3.0 t/BDt and the washing efficiency of the washer is E = 7.0. The unwashed pulp flow contains 140 kgCOD/BDt. The wash liquid has the COD-concentration 400 mg/l. Calculate the washing loss in the washed pulp (use unit kgCOD/BDt). Calculate COD-concentration in the filtrate, which leaves from the washer (use unit mg/l). Assume that density of liquids is 1000 kg/m^3.

4. A pulp mill is operated at the production rate 2000 BDt/d. A washing plant between continuous digester and oxygen delignification contains a pressure diffuser and a pressure filter. The discharge consistency of the pressure filter is 12% and the wash loss 110 kgCOD/BDt. The wash liquid flow to the pressure filter is 220 liters/s and the COD-concentration 13.0 g/l. The discharge consistency of the continuous digester is 10% and the washing loss is 650 kgCOD/BDt. Assume liquid density 1000 kg/m^3.

   a) What is the dilution factor of the washing plant?
   b) Calculate the washing efficiency of the washing plant (E_{10}-value)
   c) What is COD concentration (g/l) in the filtrate leaving from the washing plant?

5. A kraft pulp mill has chemical losses as follows
   - Liquid losses 3.0 kg Na/BDt + 0.5 kg S/BDt
   - Dust losses 1.5 kg Na/BDt + 0.5 kg S/BDt
   - Sulphurous gases 1.5 kg S/BDt

   Sulphur flow from the tall oil plant to the chemical cycle is 1.5 kg S/BDt (all goes to the chemical cycle). The mill uses fuel oil in the lime kiln. This adds 2.0 kg S/BDt to the chemical cycle. The fly ash of the recovery boiler contains 100 % Na_2SO_4. The mill uses Na_2SO_4 and NaOH as make-up chemicals. Draw a vector diagram. How much fly ash from the recovery boiler should remove (kg/BDT) to achieve equilibrium? How much is needed make-up chemical (Na_2SO_4 or NaOH)?

6. Washing line contains following washers in series: a wash press (efficiency E_{30} =1.2), a rotary vacuum filter (E_{12} = 2.9) and a pressure filter (E_{15} = 5.0). The dilution factor of the washing line is DF = 2.5 t/BDt. What is the E_{10} value of the washing line (wash press – rotary vacuum filter – pressure filter)?