(2.10) In a distillation column with total reflux, ^{10}B is enriched through exchange distillation of $BF_3O(C_2H_5)_2$ from the natural value of 20 atom % to a product containing 95% ^{10}B. The packed column has a length of 5 m and a diameter of 3 cm. What is the approximate height of a theoretical stage if the enrichment factor is 0.026?

The enrichment factor is defined as α - 1 (p. 31 below eqn. (2.47)), hence we can calculate a as:

$$\alpha := 1 + 0.026$$

The column height, *h*, is given as:

$$h := 5 \cdot m$$

The product and feed atomic fractions are:

$$x_p := \frac{95}{100} \qquad x_f := \frac{20}{100}$$

Using eqn. (2.50) we can estimate the number of theoretical stages, *N*p, as:

$$Np := \frac{\ln\left[\frac{x_p \cdot (1 - x_f)}{x_f (1 - x_p)}\right]}{\ln(\alpha)} \qquad Np = 168.723$$

The height of a theoretical plate, HETP, is then given by the height divided by the number of theoretical plates:

$$HETP := \frac{h}{Np} \qquad HETP = 0.030 \cdot \mathrm{m}$$