

Estimate enthalpy and entropy changes for a biomass ammonia pretreatment process

【Associated Sections in Selected Textbooks】

- *Introduction to Chemical Engineering Thermodynamics* [1] Sec. 6.1

【Module Learning Objectives】

- Calculation of enthalpy and entropy values from PVT and heat-capacity data.

【Problem】

Biofuels produced from various lignocellulosic materials, such as wood, agricultural, or forest residues, have the potential to be a valuable substitute for, or complement to, gasoline. Many physicochemical structural and compositional factors hinder the hydrolysis of cellulose present in biomass to sugars and other organic compounds that can later be converted to fuels. The goal of pretreatment is to make the cellulose accessible to hydrolysis for conversion to fuels. Various pretreatment techniques change the physical and chemical structure of the lignocellulosic biomass and improve hydrolysis rates [2]. During the past few years a large number of pretreatment methods have been developed and one of the pretreatment reagents is ammonia.

Estimate the change in enthalpy and entropy when liquid ammonia at 270 K is compressed from its saturation pressure of 381 kPa to 1,200 kPa. For saturated liquid ammonia at 270 K, $V^l = 1.551 \times 10^{-3} \text{ m}^3 \text{ kg}^{-1}$, and $\beta = 2.095 \times 10^{-3} \text{ K}^{-1}$.

Bibliography

- [1] J. Smith, H. Van Ness and M. Abbott, *Introduction to Chemical Engineering Thermodynamics*, 7th Ed. ed., New York: McGraw Hill, 2005.
- [2] P. Kumar, D. M. Barrett, M. J. Delwiche and P. Stroeve, "Methods for pretreatment of lignocellulosic biomass for efficient hydrolysis and biofuel production," *Industrial & Engineering Chemistry Research*, vol. 48, pp. 3713--3729, 2009.