# Calculation of gas compressibility factors of a gas well and comparison with manually read values - A.Gurkan Iscan - Cyprus International University

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**Abstract**

Gas well and gas reservoir evaluations constitute a major challenge with the need of several gas and reservoir parameters. The gas phase requires special focus other than the oil phase. The major difference is the compressibility and the viscosity. There are charts for viscosity reading and a well-known Standing chart for gas compressibility "z". In this study, the emphasis is over the compressibility factor. This factor is commonly read from the Standing and Katz Compressibility of Natural Gases Chart (1942) manually. The chart is based on utilization of reduced pressure and temperature. However, for practical and fast utilization a calculation of the compressibility factor was needed. Therefore, this study used the compressibility equations which were driven by Dranchuk and Abou Kassem (1975) to calculate "z" values. In this study, a gas reservoir well pressure data were used as the input pressures. The composition of the gas is not available. Therefore, the calculation of the pseudo-critical pressure and pseudo-critical temperature could be calculated using the specific gravity of the gas. The critical properties were calculated by employing the critical pressure and critical temperature correlations as provided by Standing (1977) using the specific gravity of the gas. The reservoir temperature is 170 F; specific gravity of the gas is 0.65. The calculated pseudo critical pressure is 671 psi and the pseudo critical temperature is 374 R. The corresponding pseudo reduced temperature is 1.68. The pseudo reduced pressure values were calculated for each pressure data in the test. The compressibility factor values were calculated at each test pressure using corresponding to the pseudo reduced properties. The compressibility factors were also read manually using the Standing and Katz Compressibility of Natural Gases Chart (1942). The both results from the calculation and the manual reading were plotted as "z" versus pseudo reduced pressure at constant pseudo reduced temperature of 1.68 (Figure 1). A very good match was observed. The calculated versus read values were plotted to see the linear regression. An R^2 value of 0.98 was calculated (Figure 2). This study validated and confirmed the applicability of the mathematical correlations to calculate the gas compressibility factors. The practical and fast applicability of these equations facilitate engineers to make robust and easier calculations in the presence of big pressure data environment in reservoir and gas well test analysis.

The compressibility factor of natural gas (which corrects for the ratio of actual volume to ideal volume) is roughly an 0.5% correction in volume per 100 psi of pressure for an orifice meter under normal pressure and temperature conditions. Hence, an error of several percent in the compressibility factor only produces a small error in volume. However, if the gas is near its critical point, correction factors of as much as 225% are required, and small errors in measured variables (temperature and pressure) are reflected as large errors in volume. These values are doubled for non-head meters.

Likewise, gases with large concentrations of non-hydrocarbon gases in their compositions are not as difficult to calculate as accurately, since new data are available from the AGA on these mixtures. Some of the theoretical values obtained by the pseudocritical method (based on the mixture composition) have shown errors of several percent when compared with empirically determined test data on the same gas. This problem becomes more pronounced as the percentage of methane is reduced. If the value of the product handled is sufficient, then actual compressibility tests are recommended to confirm that the calculated data complies with the tolerances required.

Accurate knowledge of transport properties of pure gases and liquids is crucial for equipment sizing in process design. The book of Poling et al. (2001) remains the reference. The methods described in this book are implemented in most simulation packages. More recently, a book on transport properties was published by Millat et al. (2005). Extensive tables of properties for gases and liquids, as well as various predictive methods can be found in Green and Perry (2008). The most important transport methods in product and process design are density ρ, viscosity η, thermal conductivity λ and diffusion coefficient D. The computation of these properties depends on the physical state, gas or liquid and low or high pressure. The temperature is another state variable with significant influence. Accuracy is a key issue. This should not be higher than required by the goal of computation, but reliable.

***Bottom Note:*** *This work is partly presented at 12th World Congress on Petroleum Chemistry at November 22-23, 2021 | Webinar*

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