Concept Of Enthalphy

In thermodynamical processes, especially power generation processes, we frequently encountered the combination of properties U + PV as a result of energy balances. Here U represent internal energy and PV represet moving boundry work which we will learn later.

For simplicity these properties defined as enthalphy.

$$H = U + PV \qquad (1)$$

In some thermodynamical tables not shown internal energy but we know H so;

$$U = H - PV \qquad (2)$$

The Ideal Gas Equation of State

We use tables to report properties of pure substance but it’s bulky and contains too much data. Because of thisreason a more accurate and more practical approach needed.

Any equation that relates the pressure, temperature and specific volume of a substance is called an equation of state.

Some equation of state are simple but some are complex. Best known equation of state is ideal gas equation of state.

Charles and Gay-Lussac experimentally determined that at low pressures the volume of a gas is proportional to its temperature. That is expressed by;

$$P = R\,(-) \qquad (3)$$

Hence;

$$Pv = RT \qquad (4)$$

Here;

$$R = \text{—} \text{ and } v = - \qquad (5)$$

R_u is universal gas constant and M is molar mass of substance.

If we rearrange eq. (3) and eq. (5);

$$P\,V = N\,R_u\,T \qquad (6)$$

Properties of ideal gas at two different states are related to each other described by;

$$\frac{\quad}{\quad} \qquad \frac{\quad}{\quad} \qquad (7)$$

Compresibility Factor

Gases deviates from ideal gas equation of state behaviour significantly at states near saturation region and the critical point (Equation not reliable at this points).

That deviation can accurately be accounted for by the introduction of a correction factor called the compresibility factor “Z”.

$$Z = \frac{\quad}{\quad} \text{ or } Pv = z\,R\,T \qquad (8)$$

$$Z = \frac{\quad}{\quad} \qquad (9)$$

If Z = 1 this means gas behaves like ideal gases otherwise it deviates ideal conditions.

Gases behave differently at given temperature and pressure but they behave very same at temperature and pressure normalized with respect to their critical values. For definition of high or low properties, we use critical temperature or pressure.

This normalization called as reduced properties.

$$P_R = \frac{\quad}{\quad} \qquad (10)$$

$$T_R = \frac{\quad}{\quad} \qquad (11)$$

When p and v or T and v are given instead of P and T, the generalized comppresibility chart can stil be used to determine the third property, but it would involve tedious trial and error. Therefore, it is neccesary to define one more reduced property called the “pseude-reduced specific volume”.

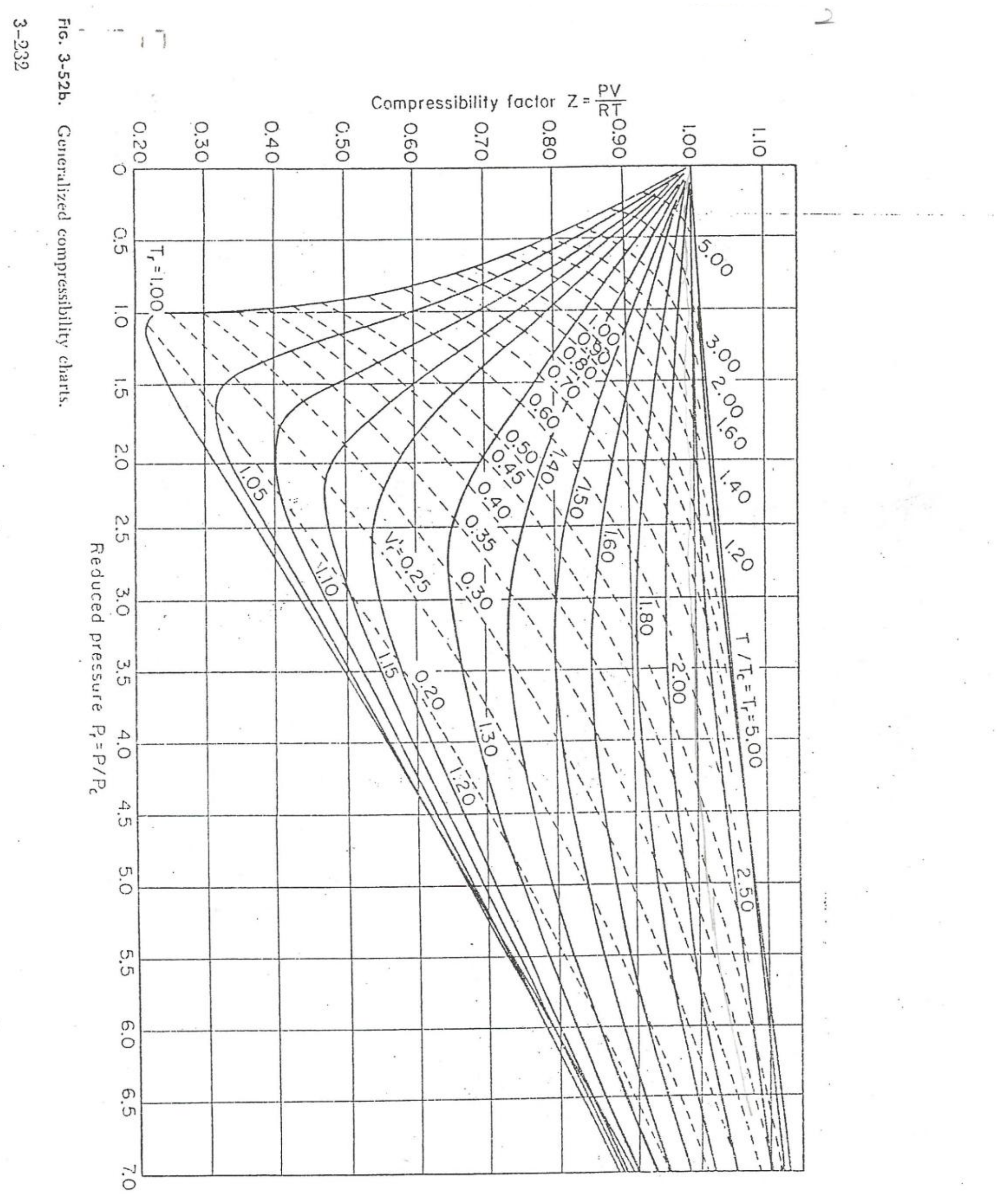

Fig.1 Generalized compresibility charts