Design Calculation of Lines when Transporting Gas Liquid Mixtures

There are a lot of methods and empirical formulas to calculate the actual gas content φ that were obtained on the basis of processing of the results of the laboratory and field studies of the gas liquid mixtures flow in vertical and horizontal lines.

The simplest of them take into account only the mixture flow rate Vm or Froude parameter Fr.

The Wallis formula for horizontal and upstream sections, as well as for slug and emulsion flow structures, looks like the following: ⟶ (1.1)

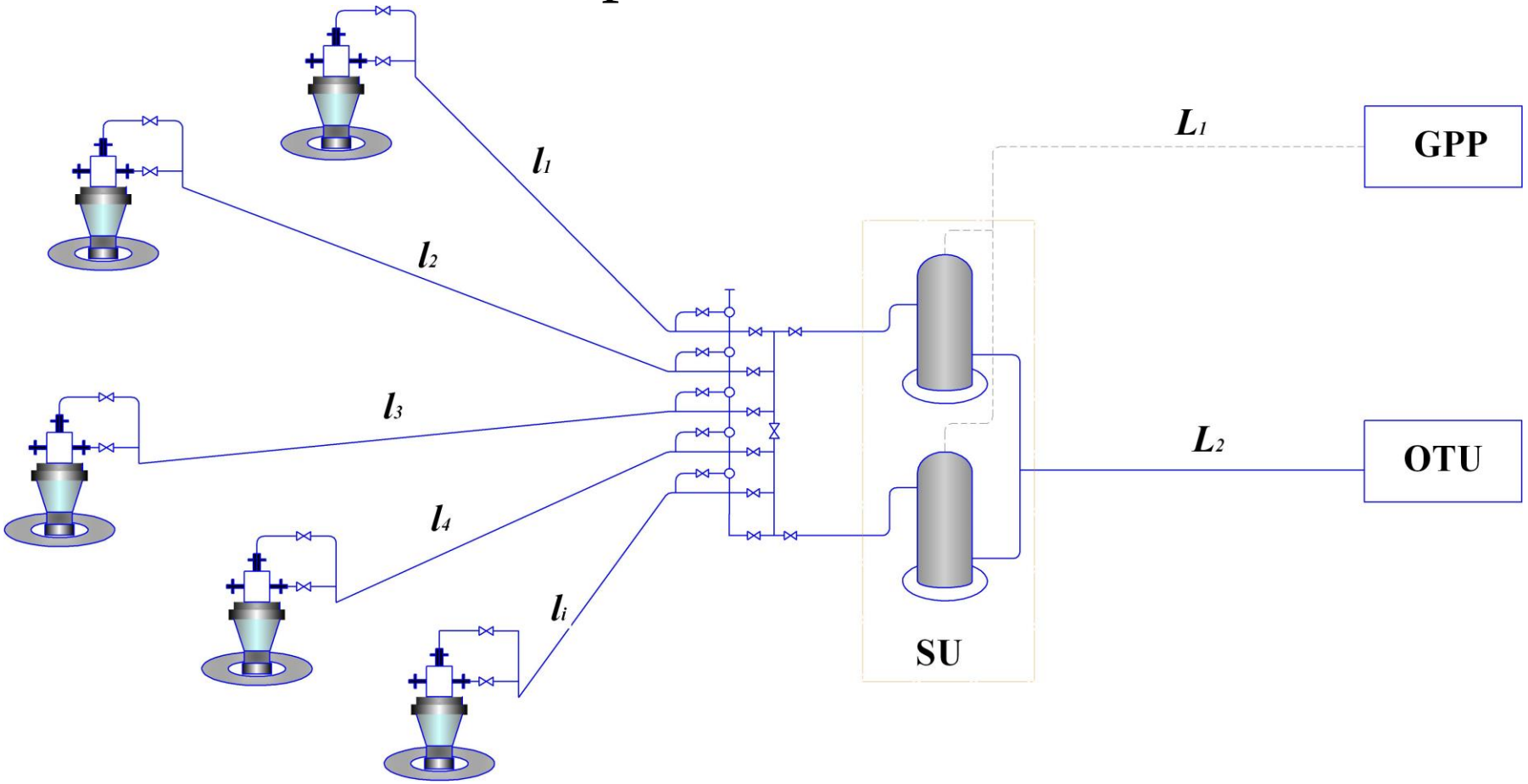
At the known (set) value of pressure, for example, at the line beginning point, liquid and gas flow rates, its length and diameter, the calculation procedure of pressure losses is carried out in the following sequence: 25_02_20

1. The mixture flow rate Vm is determined.

Volumetric gas flow rate Qg depends on the thermodynamic conditions during its transportation. If the volumetric gas flow rate is determined by the known gas ratio G, then

Qg=

We set in the first approximation the probable pressure at the wellhead, higher than the pressure at the inlet of the separation unit.



After that, the average pressure in the pipeline is found

where P is an arithmetic mean value of pressure in the line; . Since the value P2 is not known, it must be assigned. It is clear that P2<P1. T - mean temperature along the line length, K; α-gas-in-oil solubility coefficient, m3/m3*Pa.

2. The consumption gas content and Froude parameter are calculated.

3. The actual gas content is determined on the basis of one of the methods mentioned above.

4. The oil liquid mixture density is determined.

At the same time, it is necessary to remember that gas density ρg also depends on the pressure and temperature.

5. The mixture viscosity μm or νm is also determined

6. The Reynolds parameter of the mixture is calculated, as well as the coefficient λm and final friction pressure losses are determined on the basis of the correspondent formulas.

Thus, the calculated value of pressure in the line end will be equal to 2_03_20

.

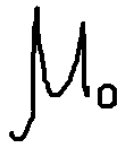
If the difference between the preset value P_2 and calculated value is less than the admissible error $|P_2-P_{2.1}| \leq 0{,}1$ MPa, the calculation stops thereupon. Otherwise, it is assumed that $P_2=P_{2.1}$ and the calculation is repeated (iteration method).

- determine the critical density of gas 

- determine the molecular weight of gas 

- define complex parameter 

- depending on the pressure and temperature determine the density of the reduced gas 

- determine the coefficient of dynamic viscosity of the gas at atmospheric pressure and temperatures 

- determine the coefficient of dynamic viscosity of the gas at pressures and temperatures T, P depending on the density of gas present