Øving 9 – 2022

Oppgave 1: Gassrørledning

(Denne oppgaven ble gitt til eksamen i masteremnet PET550, august 2015)

Når man kun tar hensyn til friksjonstrykktap, og antar at Darcy's friksjonsfaktor samt rørdiameteren er konstant, vil ligningen for steady state rørstrøm reduseres til:

$$\begin{aligned} -\frac{\mathrm{d}p}{\mathrm{d}L} &= \frac{1}{2} f_D \frac{\rho\, u^2}{D} \\ &= \\ &= K \cdot \rho\, u^2 \end{aligned}$$

a) Med $\rho\, u = \dot{m}/A$, og $\rho = p/zRT$ vis at

$$\mathrm{d}L = -\frac{A^2}{K\, zRT\, \dot{m}^2} \cdot p\, \mathrm{d}p$$

b) Følgende data er oppgitt:

Innnløpstrykk;	p_1	= 137 bar
Utløpstrykk;	p_2	= 85 bar
Lengde for rørledning;	L	= 540 km
Tverrsnittsareal;	A	= 0.46 m^2
Gas gravity;	γ	= 0.63
Gjennomsnittlig z-faktor;	$\bar{z}$	= 0.94
Gjennomsnitlig temperatur:	$\bar{T}$	= 7.3 °C
Konstant;	K	= 0.0065 m^{-1}

Hvor mange kg gass pr. sekund vil strømme gjennom rørledningen ?

Weymouthligningen blir vanligvis brukt til denne typen problem, og gir gass-strømmen i std. m^3 pr. døgn. For enheter i SI-systemet skrives ligningen slik:

$$\dot{q}_{SC} = 1.185 \cdot 10^7 \cdot \left(\frac{T_{SC}}{p_{SC}}\right) \cdot \sqrt{\frac{(p_1^2 - p_2^2)\, D^{5.333}}{\gamma\, L\, \bar{T}\, \bar{z}}}$$

Siden konstanten ikke er dimensjonsløs, må alle trykk settes inn i kPa, temperaturen i K, og lengden og diameteren i m.

c) Hva blir gass-strømmen for problemet i **b** i Sm^3/d ? (Rørtverrsnittet er sirkulært)

d) Hva blir prosentvis avvik mellom disse to beregningsmetodene ?

Oppgave 2: Gassløft

Gas lift is being commenced for a production well in order to keep the production rate at a minimum of 600 stb/d. Earlier investigations have reveiled that increasing the GOR from the "natural" value of 1500 scf/stb up to 2000 scf/stb by recycling 1/3 of the produced gas will suffice. The 300.000 scf/d is to be recompressed from the wellhead pressure of 1450 psi, and injected throug pre-installed gas lift valves right above the perforation zone.

(This is the same well as in Exercise 5)

Key data:

Well depth (= depth of valve):	D_v	= 10.000 ft
Pressure difference, valve:	Δp_v	= 100 psi
Gas gravity:	γ_g	= 0.65
Average gas temperature:	T	= 95 °F
Average z-factor:	$\bar{z}$	= 0.9
Adiabatic exponent:	k	= 1.24

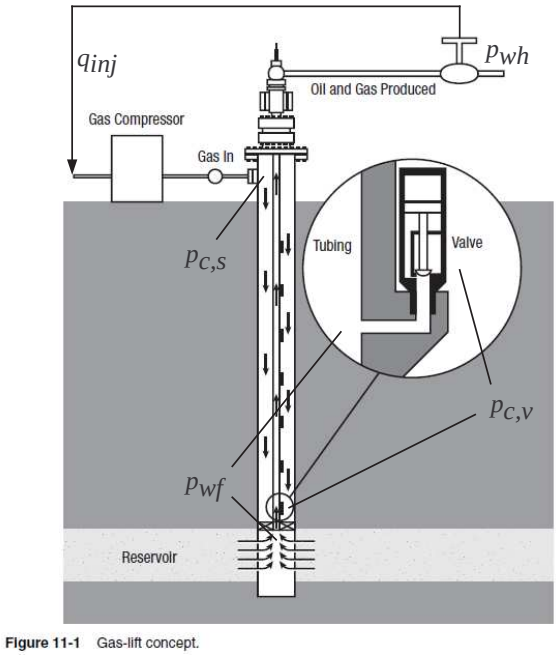

Figure 11-1 Gas-lift concept.

Figur 1: Gas lift concept [2], with pressure locations

a) The increased GOR will reduce the bottom hole pressure p_{wf} to 2900 psia (from previous 3320 psia). What will be the necessary casing pressure $p_{c,v}$ at the gas lift valve ?

b) Neglecting frictional pressure drop through the annulus, what is the corresponding casing pressure $p_{c,s}$ at the surface ?

c) Calculate the theoretical work input (per mass unit), necessary to run the gas lift compressor.

Referanser

[1] Guo, B., Liu, X., Tan, X.: *Petroleum Production Engineering*, 2nd Ed., Gulf Professional Publishing, 2017, ISBN 978-0-12-809374-0

[2] Economides, M.J., Hill, A.D., Ehlig-Economides, C., Zhu, D.: *Petroleum Production Systems*, Prentice Hall, 2nd Ed, 2012, ISBN 0-13-703158-0