Air Calc.

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The followings formula can be used to calculate the theoretical volume of water required to raise the pressure in the pipeline:

$$\frac{\Delta V}{\Delta P} = PV \times \left[\frac{D \times (1-u2)}{Et} + \frac{1}{B}\right]$$

Where

ΔV	= incremental volume	(in m3)
Δp	= incremental pressure	(in bar)
PV	= Pipeline volume	(in m3)
D	= Pipeline outside diameter	(in m)
T	= Pipeline wall thickness	(in m)
E	= Young's elastic modulus of steel	= 2.07 x 106 bar
u	= Poisson's ratio	= 0.3 bar (For CS Pipes)
B	= Bulk modulus of water in bar based on temperate	(in Ċ)

$PV := 597.0738\ m^3$

Poisson's ratio for DSS

$\nu := 0.3$

$E := 2.00 \cdot 10^6\ bar$

$T := 10.5\ mm = 0.0105\ m$

$B := 22656.25\ bar$

$D := 16\ in = 0.4064\ m$

Test Pressure on DWT (initial)

$P_1 := 5\ bar$

Test Pressure on DWT (final) (deadweight tester)

$P_2 := 35.50\ bar$

Incremental Pressure

$\Delta P := P_2 - P_1 = 30.5\ bar$

Incremental Volume

$$\Delta V := \left| PV \cdot \left| \frac{D \cdot \left[1 - \nu^2\right]}{E \cdot T} + \frac{1}{B} \right| \right| \cdot \Delta P = 1.1245\ m^3$$

$V_{Theoretical} := \Delta V = 1.1245\ m^3$

$V_{Actual} := 1210.0\ L = 1.21\ m^3$

Percentage of air content

$$V_{Air\%} := \frac{\left[V_{Actual} - V_{Theoretical}\right]}{PV} \cdot 100 = 0.0143$$