论文输入输出实例

计算机科学与技术 专业

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摘要

关键词：流体力学，计算机并行，平衡点

1 example

1.1 通用数据

表格 1.1 通用数据

变量	数值
管柱的长度 *L*	*12000in.*
空气中每单位长度管柱平均重量w_s	*0.542lbm/in.*
内径r_i	*1.22in*
外径r_o	*1.438in*
外力 *F*	*20000lbf*
外径内径比例 *R*	*1.178*
I	$1.61in.^4$
管柱内液体密度ρ_i	$15lbm/gal$
环空内液体密度ρ_o	$7.31lbm/gal$
管柱内加压p_i	*5000Psi*
环空内加压p_o	*1000Psi*
封隔器通径r_p	*3.25in*
r	*1.61in.*
δ	*0*
Δt	$-20°\mathrm{F}$

表格 1.2 单位转换表

ft	*m*	*1ft=0.3048m*
in	*mm*	*1in=25.4mm*
ft	*in*	*1ft=12in*
lbm[1]	*kg*	*1lbm=0.454kg*
lbf	*N*	*1lbf=4.45N*
Mpa	*Psi*	*1Mpa=145Psi*
gal	*cu ft.*	*1gal=0.1336808cu ft.*
Psi	*lbs/sq in.*	*1Psi=1lbs*[2]*/sq in.*

根据表 1. 1 可得

$$A_o = \pi r_e^2 = 6.49sq\ in.$$

$$A_i = \pi r_e^2 = 4.68sq\ in.$$

$$A_s = A_e - A_i = 1.81sq\ in.$$

$$A_p = \pi r_p^2 = 8.30sq\ in.$$

$$\mathrm{P_i = p_i + \rho_i L \quad P_o = p_o + \rho_o L} \tag{1.1}$$

$$\mathrm{W = W_s + W_i - W_o = W_s + \rho_i A_i - \rho_o A_o} \tag{1.2}$$

初始密度为$\mathrm{\rho_i = \rho_o = 7.31lbm/gal = 0.0317Psi/in.}$，最终密度为$\mathrm{\rho_i = 15lbm/gal =}$

[1]英制重量单位， 一般 lb 是表示力的单位--磅，也有时表示压力、质量 ，通用。为了区别起见，lbm 专门表示质量，lbf 专门表示力。
[2] lb 的复数是 lbs

0.0649Psi/in.，$\rho_o = 7.31\text{lbm/gal} = 0.0317\text{Psi/in.}$。所以密度变化为$\Delta\rho_i = 0.0332\text{Psi/in.}$，$\Delta\rho_o = 0$。

初始压力为$p_i = p_o = 0$，根据公式(1.1)，$P_i = P_o = 3800\text{Psi}$。最终压力为$p_i = 5000\text{Psi}$，$p_o = 1000\text{Psi}$，根据公式(1.1)，$P_i = 12790\text{Psi}$，$P_o = 4800\text{Psi}$。所以压力变化值为$\Delta p_i = 5000\text{Psi}$，$\Delta p_o = 1000\text{Psi}$，$\Delta P_i = 8990\text{Psi}$，$\Delta P_o = 1000\text{Psi}$。

根据公式(1.2)及上述初始和最终密度数值，可得，每单位长度的质量初始值为$W = 0.484\text{lbm/in.}$，最终值为$W = 0.640\text{lbm/in.}$。

1.2 EXAMPLE 1-PACKER PERMITTING FREE MOTION

$$F_f = A_p(P_i - P_o) \tag{1.3}$$

$$F_a = (A_p - A_i)P_i - (A_p - A_o)P_o \tag{1.4}$$

$$\Delta L_1 = -\frac{LF}{EA_s} \tag{1.5}$$

$$\Delta L_2 = -\frac{r^2F^2}{8EIw} \tag{1.6}$$

$$\Delta L_1 = -\frac{L}{EA_s}\left[(A_p - A_i)\Delta P_i - (A_p - A_o)\Delta P_o\right] \tag{1.7}$$

$$\Delta L_2 = -\frac{r^2A_p^2(\Delta P_i - \Delta P_o)^2}{8EI(W_s + W_i - W_o)} \tag{1.8}$$

$$\Delta L_3 = -\frac{v}{E}\frac{\Delta\rho_i - R^2\Delta\rho_o - \frac{1+2v}{2v}\delta}{R^2-1}L^2 - \frac{2v}{E}\frac{\Delta p_i - R^2\Delta p_o}{R^2-1}L \tag{1.9}$$

$$\Delta L_4 = L\beta\Delta t \tag{1.10}$$

$$\Delta L = \Delta L_1 + \Delta L_2 + \Delta L_3 + \Delta L_4 \tag{1.11}$$

$$n = \frac{F}{W} \tag{1.12}$$

$$P = -\sqrt{\frac{8EI}{F}} \tag{1.13}$$

根据公式(1.7)(1.8)(1.9)(1.10)可得，$\Delta L_1 = -67.92\text{in.}$，$\Delta L_2 = -46.10\text{in.}$，$\Delta L_3 = -34.69\text{in.}$，$\Delta L_4 = -16.56\text{in.}$，所以$\Delta L = -165.27\text{in.}$

根据公式(1.3)(1.4)可得$F_f = 66317\text{lbf}$，$F_a = 37611.8\text{lbf}$。

根据公式(1.12)，及$F_f = 66317\text{lbf}$，$W = 0.640\text{lbm/in.}$可得$n = 103620\text{in.} = 8535\text{ft}$。

1.3 EXAMPLE 1-PACKER PERMITTING LIMITED MOTION

1.4 EXAMPLE 2- PACKER PERMITTING LIMITED MOTION

1.5 EXAMPLE 2-PACKER PERMITTING NO MOTION

术语：

F= externally applied force (positive if a compression), Ibf (N) 施加的外力

W_s = average weight in air of the tube per unit length, Ibm/in. (g/mm) 空气中的每单位长度的管平均重量

A_S = cross-sectional area of the tubing wall, sq in.(mm2) 管壁的横截面积

p_i=surface tubing pressure, Psi

p_o=surface annulus pressure, Psi

P_o = pressure outside the tube at the packer level, psi (Pa)

P_i = pressure inside the tube at the packer level, psi (Pa)

A_P = area corresponding to packer bore ID, sq in. (mm2)

A_i= area corresponding to tubing ID, sq in. (mm2)

A_o= area corresponding to tubing OD, sq in. (mm2)

F_f = fictitious force in presence of no restraint in the packer,lbf

F_a= actually existing pressure force at the lower end of the tubing subjected to no restraint in the packer ,lbf

v=Poissin's ratio of the material (for steel ,v=0.3)

β=coefficient of thermal expansion of the tubing material(for steel,$\beta = 6.9 \times 10^{-6}/1$°F)

δ=drop of pressure in the tubing due to flow per unit length

Δt=change in average tubing temperature

ΔL_1=length change of the tubing due to Hooke's law,胡克定律产生的形变由公式(1.5)定义

ΔL_2=length change of the tubing due to helical buckling,变形弯曲产生的形变由公式(1.6)定义

ΔL_3=length change of the tubing due to radial pressure forces and flow through the tubing,径向压力和液体流动产生的形变由公式(1.9)定义

ΔL_1=length change of the tubing due to temperature change,温度变化产生的长度变化由公式(1.10) 定义

ΔL=Over-all tubing change due to flow and to changes of pressure, temperature and density,压力，温度，密度和液体流动产生的管柱总长度变化，由公式 (1.11)定义

参考文献

[1]Lubinski A,Althouse W S,Logan J L. Helical Buckling of Tubing Sealed in Packers[J]. Journal of Petroleum Technology, 1962, 14(6):655-670

附录

中立点（neutral point），就是在这个点上方管柱不发生形变，在这个点下方管柱弯曲。