

k ,

10 [4].

e

U

[5]

$$U \approx \frac{A_1}{\rho c}, \quad (1)$$

(1425 /).

(1)

U [5].

h/d ,

v_2

$h/d > 1$

) [6].
 $h/d = 1, 0,5$

1,0 1,37 [6],

[6].

$$= 0,4 \quad r/d = 0,5, \quad h/d = 0,18, \quad 0,08 < h/d < 0,18$$

$$(\quad = 1,2 \quad h/d = 0,08),$$

h ,

$$h/d < 0,2 [7].$$

$$\mu = 0,62,$$

$$h = d/4 \quad (h/d = 0,25),$$

$$F_3 = dh$$

$$F_2 = d^2/4.$$

$$(h < d/4)$$

h .

() ,

$$(h < d/4),$$

v_m ,

v_m

P ,

$$z = z.$$

v_m

: 1-1

2-2

0-0,

$$\frac{1}{g} - z + \frac{\alpha v_1^2}{2g} = \frac{p_2}{g} + \frac{v_2^2}{2g} + \zeta \left(\frac{v_2^2}{2g} + \frac{l_1 - z}{g} \frac{d^2 z}{dt^2} \right). \quad (2)$$

v_1 , 1-

1-1; v_2 , 2-

$$(2-2); \frac{l_1 - z}{g} \frac{d^2 z}{dt^2}$$

1-2,

$$\left(\frac{dv}{dt} \right) > 0;$$

$$= \frac{l_1}{d};$$

$$F_3 = k_0 \left(\frac{h}{h+z} \right)^n, \quad (3)$$

$$Q = \mu F_3 \sqrt{2(p_2 - p'_0)}, \quad (4)$$

$$p'_0 = \rho_0 + g(H + l_1).$$

$$Q = v_1 F_1 = v_3 F_3, \quad (5)$$

$$(2) \dots (5) \quad \frac{(l_1 - z) d^2 z}{g dt^2} \approx \frac{l_1}{g} \frac{d^2 z}{dt^2},$$

$$F_1 = F_2; v_1 = v_2 = v; \rho_1 =$$

$$= \rho_2 = 1,$$

$$\frac{k_0}{g} \left(\frac{h}{h+z} \right)^n = \frac{v^2}{2g} \left[\frac{1}{2} \left(\frac{F_1}{F_3} \right)^2 + \zeta \right] + \frac{l_1}{g} + z + \frac{l_1}{g} \frac{d^2 z}{dt^2}. \quad (6)$$

$$\frac{d^2 z}{dt^2} = 0, \quad z = z, \quad v = v_m, \quad \frac{d^2 z}{dt^2} = 0. \quad (6)$$

$$v_{\max} = \sqrt{\frac{2 \left[\frac{k p_0}{\rho} \left(\frac{h}{h+z'} \right)^n - \frac{p}{\rho} - g(H + l_1 + z') \right]}{\frac{1}{\mu^2} \left(\frac{F_1}{F_3} \right)^2 + \zeta}}. \quad (7)$$

$$(6) \quad \frac{dz}{dt} = v; \quad \frac{d^2 z}{dt^2} = \frac{dv}{dt} = v \frac{dv}{dz},$$

$$v \frac{dv}{dz} = \frac{k p_0}{\rho l_1} \left(\frac{h}{h+z} \right)^n - \frac{v_y^2}{2l_1} \zeta - \frac{g}{l_1} (H + l_1 + z), \quad (8)$$

$$v_y = \dots; \quad (7)$$

$$\zeta = \left[\frac{1}{\mu^2} \left(\frac{F_1}{F_3} \right)^2 + \zeta \right].$$

$$\frac{v^2}{2} = \frac{k_0 h^n}{\rho l_1 (h+z)^{n-1} (1-n)} - \frac{\zeta}{2l_1} z v_y^2 - \frac{p}{\rho l_1} z - \frac{g(H+l_1)z}{l_1} - \frac{z^2}{2l_1} + C. \quad (9)$$

$$z=0; v=0$$

$$= \frac{k p_0 h^n}{l_1 (n-1)}. \quad (10)$$

$$(10) \quad (9) \quad z = z, \quad v_m$$

$$v_m = \sqrt{\frac{1}{l_1} \left\{ \frac{2k p_0 h}{\rho(n-1)} \left[1 - \left(\frac{h}{h+z} \right)^{n-1} \right] - \zeta v_m^2 z' - \sqrt{2z \left[\frac{p}{\rho} + g(H+l_1) + \frac{gz^2}{2} \right]} \right\}}. \quad (11)$$

$$(7), (11)$$

v_m ,

$$S \quad 2-2, 3-3,$$

4-4.

$N,$

P

$$(P = -N).$$

Z

$$P = k_2 + \dots \quad (12)$$

$$k_2 - \\ v = v_m ; \dots$$

$$2-2 \quad Z$$

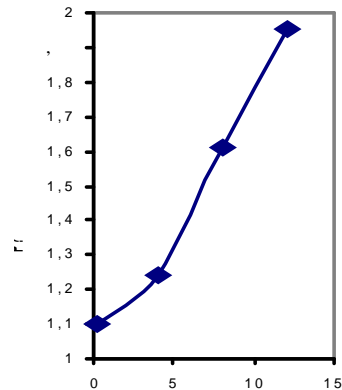
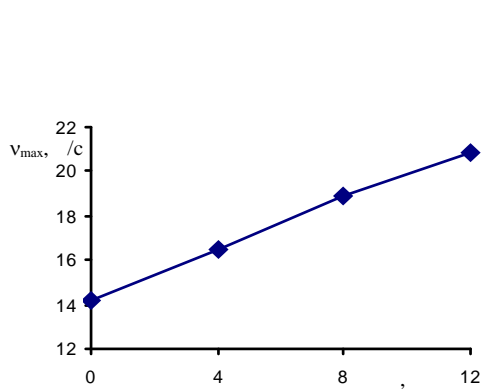
$$k_2 = \dots Q_m v_m = \dots v_{\max}^2 F,$$

$$\dots \quad (4) \quad \dots v_m$$

$$2 = (p_2 - \dots) F = \left(\frac{v_{\max}^2}{2\mu^2} \right) (F/F_3)^2 F.$$

$$P = \rho v_m^2 \left[1 + \frac{1}{2\mu^2} \left(\frac{F}{F_3} \right)^2 \right] F = \dots F, \quad (13)$$

$n = 1,17$; $\mu = 0,62$; $\zeta = \lambda \frac{l_1}{d} = 0,017 \frac{0,075}{0,05} = 0,026$; $\lambda = 2,63$.



$h = 0,0125$; $z = 4$; $\mu = 0,62$; $n = 1,17$; $\lambda = 2,63$; $\frac{l_1}{h} = 3 = \text{const}$.

h	l_1	z	v_m , /	P	μ
0,025	0,075	0,034	16,5	1,24	0,63
0,05	0,15	0,065	16,5	1,24	0,63
0,075	0,225	0,102	16,5	1,24	0,63
0,1	0,3	0,135	16,5	1,24	0,63

$\frac{l_1}{h} = 3 = \text{const}$; v_m , R , z' .

$$I = \int_0^t (t) dt .$$

$$= 0,075 ; \frac{l_1}{h} = 3 = \text{const}; \quad = 4 ; \mu = 0,62; n = 1,17 \quad . 2.$$

h

/	h,		z,	v _m , /	v _{m 3} , /	P,	,
1	0,0125	2,63	0,034	16,5	16,5	1,24	0,63
2	0,01	4,08	0,027	14,6	18,2	1,26	0,65
3	0,0083	5,8	0,023	13,1	19,6	1,31	0,67

$$h \frac{d}{4} \frac{d}{6}, \dots c 0,0125$$

$$0,0083 (\dots 2),$$

$$P$$

1.

2.

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2. . . . 1650279 // - 1991. - 24.
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