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Importance of Sucker Rod Pump [SRP] in Artificial Lift

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Abstract: The driving force which displaces oil from a reservoir come from the natural energy of compressed fluid stored in the reservoir when this natural energy associated with oil will not produce sufficient pressure differential between reservoir and wellbore to leave reservoir fluid up to surface then the reservoir energy must be supplemented by some form of artificial methods. Sucker rod pumping is an old technique in the oil industry for lifting crude oil from oil wells and is most widely used mode of artificial lift system. In this project work an attempt has been made to study the working, designing and problems of an SRP system. It is efficient, simple, and easy for field people to operate, and can be used to pump a well at very low bottom-hole pressure to maximize oil production rates.

I. INTRODUCTION ARTIFICIAL LIFT METHODS

Artificial lift is a means of overcoming bottom hole pressure so that a well can produce at some desired rate, either by injecting gas into the producing fluid column to reduce its hydrostatic pressure, or using a down hole pump to provide additional lift pressure down hole. We tend to associate artificial lift with mature, depleted fields, where P_{avg} has declined such that the reservoir can no longer produce under its natural energy. But these methods are also used in younger fields to increase production rates and improve project economics. It is used to lower the producing Bottom Hole Pressure (BHP) on the formation to obtain a higher production rate from the well.

II. TYPES OF ARTIFICIAL LIFT METHODS

A. Sucker-Rod Pumping (Bean Pump)
B. Electrical Submersible Pumping (ESP)
C. Gas Lift and Intermittent Gas Lift
D. Reciprocating and Jet Hydraulic Pumping Systems
E. Plunger Lift
F. Progressive Cavity Pumps (PCP)

G. Units of Sucker Rod Pump

Sucker rod pump is an old technique in the oil industry from lifting the crude oil from the oil wells and it is mostly used method of artificial lift system. Approximately 80 to 90% artificial lift wells operating on sucker rod pumps [SRP].Simple strategy of the pumping unit is broadly divided into three units namely:

1) Surface Unit
2) Sub Surface Sucker Rod Pump
3) Sucker Rods

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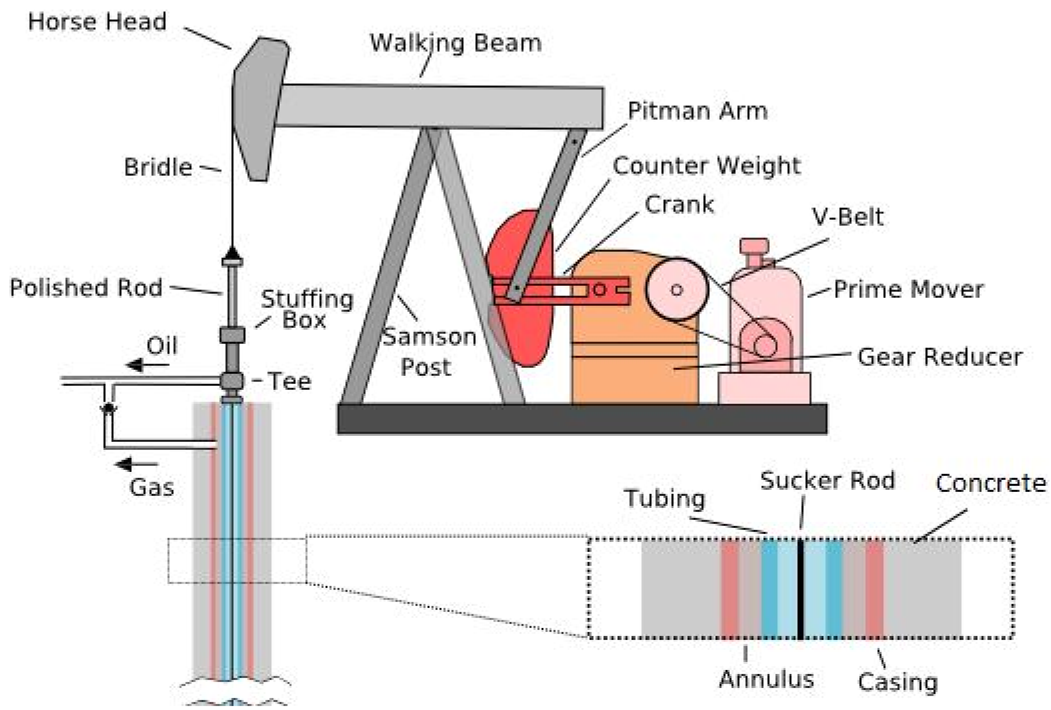


Fig 2.1: Schematic of a Sucker rod pump

In brief, each of these units are described in detail and how they are linked together into a unique pumping system. With the help of prime mover, say an electric motor of comparatively low r.p.m. (like 720 r.p.m.) a rotating motion is generated. The rotating motion is then converted to reciprocating or vertical motion with the help of surface unit. This linear reciprocating motion is then transmitted to sub-surface sucker rod pump through the sucker rods, which is the linkage between the surface unit and subsurface pump.

III. CASE STUDY

A. Case study3.1

1) Symbols and formulas

B. Symbols, with units where applicable

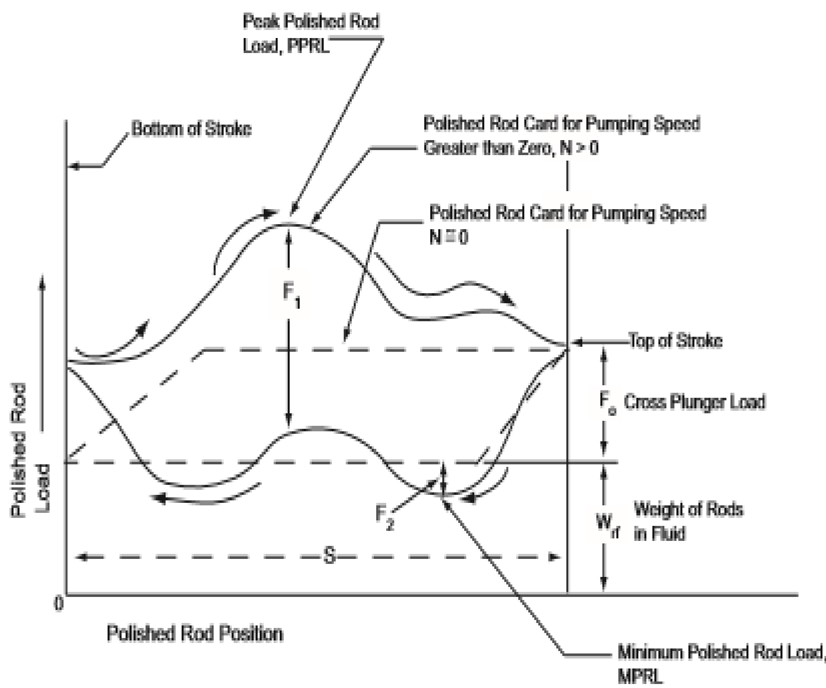
CBE- Counter Weight Required, lb
D- Plunger diameter, in.
Er- elastic constant- rods, in./lb-ft
Et- elastic constant- tubing, in./lb-ft
F1- PPRL factor
F2-MPRL factor
Fc- frequency factor
F0- differential fluid load on full plunger area, lb
F3- PRHP factor
G- specific gravity of produced fluid
H- net lift, ft
L- pump depth, ft
MPRL- minimum polished rod load, lb
N- pumping speed ,SPM
N0- natural frequency of straight rod string, SPM
N01- natural frequency of tapered rod string, SPM
PD –pump displacement, barrels/day

PPRL- peak polished rod load, lb

PRHP –polished rod horsepower
PT- peak crank torque, lb-in.
S- polished rod stroke, in.
SKr – lb of load necessary to stretch the total rod string an amount equal to the polished rod stroke ,S
Sp- bottom hole pump stroke, in.
SPM- strokes per minute
T- crank torque, lb-in.
Ta- torque adjustment constant for values of Wrf/SKr other than 0.3
W- total weight of rods in air, lb
Wr- average unit weight of rods in air, lb-ft
Wrf- total weight of rods in fluid, lb
1/Kr- elastic constant-total rod string, in/lb
1/Kt- elastic constant-unanchored portion of tubing string , in./lb

C. Formulas

An understanding of this formulas utilized for the solution of sucker rod pumping problems will be refering by this basic dynagraph card.



Basic dynagraph card

a) At pumping speed, $N \cong 0$

peak polished rod load, $PPRL = W_{rf} + F_o$

minimum polished rod load, $MPRL = W_{rf}$

b) For pumping speed, $N > 0$

peal polished rod load, $PPRL = W_{rf} + F_1$

minimum polished rod load, $MPRL = W_{rf} - F_2$

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The problem is generalized by using parameters of variables that are non-dimensional

1) The indipendent non-dimensional variables are

$$N/N_o \text{ (Dimensionally} = SPM/SPM = 1\text{), and}$$

$$F_o/Sk_r \text{ (Dimensionally} = \frac{\text{lb}}{\text{in.} \times \text{lb/in.}} = 1)$$

Where

N is SPM
N_o is SPM at natural frequency of rod string
S is surface stroke
k_r is spring constant of rod string

2) The dependent non-dimensional variables are

peak polished rod load, $PPRL$:	F_1/Sk_r
minimum polished rod load, $MPRL$:	F_2/Sk_r
peak torque, PT:	$2T/S^2k_r$
polished rod horsepower, $PRHP$:	F_3/Sk_r
plunger stroke, S_p:	S_p/S

Pluger srtoke,

$$S_p = [(S_p/S) \times S] - [F_o \times 1/k_t]$$

NOTE : When tubing is anchored , the value of 1/Kt equals zero, therefore the formula for Sp with anchored tubing becomes

$$(S_p/S) \times S.$$

Pump displacement,

$$PD = 0.1166 \times S_p \times N \times D^2$$

Peak polished rod load,

$$PPRL = W_{rf} + [(F_1/Sk_r) \times Sk_r]$$

Minimum polished rod load,

$$MPRL = W_{rf} - [(F_2/Sk_r) \times Sk_r]$$

Peak torque,

$$PT = (2T/S^2k_r) \times Sk_r \times S/2 \times T_a$$

Polished rod horsepower,

$$PRHP = (F_3/Sk_r) \times Sk_r \times S \times N \times 2.53 \times 10^{-6}$$

Counter weight required,

$$CBE = 1.06\,(W_{rf} + {}^1/2\,F_o)$$

IV. EXAMPLE DESIGN CALCULATIONS CONVENTIONAL SUCKER ROD PUMPING SYSTEM: API TECHNICAL REPORT 11L (CONVENTIONAL UNITS)

From that Example design calculations

To Solve Sp, PD, PPRL, MPRL, PT, PRHP and CBE

A. Given Data

Fluid Level, H=4500 ft
Pumping Speed, N=16 SPM
Plunger Diameter, D=1.50 in
Pump Depth, L=5000 ft
Length of the stroke, S=54 in
Specific Gravity of Fluid, G=0.9
Tubing Size= 2 in

B. From Table

1) Wr = 1.833 (lb/ft)
2) Er = 0.804*10^-6 (in/lb-ft)
3) Fc = 1.082
4) Et = 0.307*10^-6

Calculate Non-dimensional variables:

5) Fo= 0.340*G*D^2*H
   =0.340*(0.9)*(1.50)^2*(4500)
   =3098 lbs
6) 1/Kr= Er*L
   =(0.804*10^-6)*(5000)
   =4.020*10^-3 (in/lb)
7) SKr= S/(1/Kr)
   =(54)/(4.020*10^-3)
   =13433 lbs
8) Fo/SKr= 3098/13433
   =0.231 lbs
9) N/No= NL/245000
   =(16*5000)/245000
   =0.326
10) N/No1= (N/No)/Fc
   = (0.326)/1.082
   =0.321
11) (1/Kt)= Et*L
   =(0.307*10^-6)*(5000)
   = 1.535*10^-3 (in/lb)Solve for Sp and PD:
12) Sp/S= 0.86 (FiBgure or Graph 4.1)
13) $S_p = [(S_p/S) \times S] - [F_o \times 1/k_t]$
   = [(0.86)*(54)]-[3098*(1.535*10^-3)]
   = 41.7 in
14) $PD = 0.1166 \times S_p \times N \times D^2$
   = 0.1166*41.7*16*(1.50)^2
   = 175 Barrels/DayDetermine Non-Dimensional Parameters:

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15) W=Wr*L
=1.833*5000
= 9165 lbs

16) Wrf= W[1-(0.128G)]
=9165[1-(0.128*0.9)]
= 8110 lbs

17) Wrf/SKr = 8110/13433
= 0.604 lbsRecord Non-Dimensional factors from graphs (4.2 through 4.6):

18) F_1/Sk_r = 0.465

19) F_2/Sk_r =0.213

20) $2T/S^2k_r$ = 0.37

21) F_3/Sk_r = 0.29

22) Ta = 0.997Solve for Operating Characteristics:

23) $PPRL = W_{rf} + [(F_1/Sk_r) \times Sk_r]$
= 8110+[(0.465)*(13433)]
= 14356 lbs

24) $MPRL = W_{rf} - [(F_2/Sk_r) \times Sk_r]$
= 8110- [0.22*13433]
= 5249 lbs

25) $PT = (2T/S^2k_r) \times Sk_r \times S/2 \times T_a$
= 0.37*13433*27*0.997
= 133793 lb inches

26) $PRHP = (F_3/Sk_r) \times Sk_r \times S \times N \times 2.53 \times 10^{-6}$
= 0.29*13433*54*16*(2.53*10^-6)
= 8.5

27) $CBE = 1.06\ (W_{rf} + {}^1/2\ F_o)$
=1.06(8110+1549)
= 10239 lbs

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Table 4.1—Rod and Pump Data (See 4.5)

1	2	3	4	5	6	7	8	9		
					Rod String, % of each size					
Rod No.	Plunger Diameter in. D	Rod Weight lb/ft W_r	Elastic Constant in./lb-ft E_r	Frequency Factor F_c	1 1/8	1	7/8	3/4	5/8	1/2
44	All	0.726	1.990×10^{-6}	1.000	—	—	—	—	—	100.0
54	1.06	0.908	1.668×10^{-6}	1.138	—	—	—	—	44.6	55.4
54	1.25	0.929	1.633×10^{-6}	1.140	—	—	—	—	49.5	50.5
54	1.50	0.957	1.584×10^{-6}	1.137	—	—	—	—	56.4	43.6
54	1.75	0.990	1.525×10^{-6}	1.122	—	—	—	—	64.6	35.4
54	2.00	1.027	1.460×10^{-6}	1.095	—	—	—	—	73.7	26.3
54	2.25	1.067	1.391×10^{-6}	1.061	—	—	—	—	83.4	16.6
54	2.50	1.108	1.318×10^{-6}	1.023	—	—	—	—	93.5	6.5
55	All	1.135	1.270×10^{-6}	1.000	—	—	—	—	100.0	—
64	1.06	1.164	1.382×10^{-6}	1.229	—	—	—	33.3	33.1	33.5
64	1.25	1.211	1.319×10^{-6}	1.215	—	—	—	37.2	35.9	26.9
64	1.50	1.275	1.232×10^{-6}	1.184	—	—	—	42.3	40.4	17.3
64	1.75	1.341	1.141×10^{-6}	1.145	—	—	—	47.4	45.2	7.4
65	1.06	1.307	1.138×10^{-6}	1.098	—	—	—	34.4	65.6	—
65	1.25	1.321	1.127×10^{-6}	1.104	—	—	—	37.3	62.7	—
65	1.50	1.343	1.110×10^{-6}	1.110	—	—	—	41.8	58.2	—
65	1.75	1.369	1.090×10^{-6}	1.114	—	—	—	46.9	53.1	—
65	2.00	1.394	1.070×10^{-6}	1.114	—	—	—	52.0	48.0	—
65	2.25	1.426	1.045×10^{-6}	1.110	—	—	—	58.4	41.6	—
65	2.50	1.460	1.018×10^{-6}	1.099	—	—	—	65.2	34.8	—
65	2.75	1.497	0.990×10^{-6}	1.082	—	—	—	72.5	27.5	—
65	3.25	1.574	0.930×10^{-6}	1.037	—	—	—	88.1	11.9	—
66	All	1.634	0.883×10^{-6}	1.000	—	—	—	100.0	—	—
75	1.06	1.566	0.997×10^{-6}	1.191	—	—	27.0	27.4	45.6	—
75	1.25	1.604	0.973×10^{-6}	1.193	—	—	29.4	29.8	40.8	—
75	1.50	1.664	0.935×10^{-6}	1.189	—	—	33.3	33.3	33.3	—
75	1.75	1.732	0.892×10^{-6}	1.174	—	—	37.8	37.0	25.1	—
75	2.00	1.803	0.847×10^{-6}	1.151	—	—	42.4	41.3	16.3	—
75	2.25	1.875	0.801×10^{-6}	1.121	—	—	46.9	45.8	7.2	—
76	1.06	1.802	0.816×10^{-6}	1.072	—	—	28.5	71.5	—	—
76	1.25	1.814	0.812×10^{-6}	1.077	—	—	30.6	69.4	—	—
76	1.50	1.833	0.804×10^{-6}	1.082	—	—	33.8	66.2	—	—
76	1.75	1.855	0.795×10^{-6}	1.088	—	—	37.5	62.5	—	—
76	2.00	1.880	0.785×10^{-6}	1.093	—	—	41.7	58.3	—	—
76	2.25	1.908	0.774×10^{-6}	1.096	—	—	46.5	53.5	—	—
76	2.50	1.934	0.764×10^{-6}	1.097	—	—	50.8	49.2	—	—
76	2.75	1.967	0.751×10^{-6}	1.094	—	—	56.5	43.5	—	—
76	3.25	2.039	0.722×10^{-6}	1.078	—	—	68.7	31.3	—	—

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1	2	3	4	5	6	7	8	9		
Rod No.	Plunger Diameter in. D	Rod Weight lb/ft W_r	Elastic Constant in./lb-ft E_r	Frequency Factor F_c	Rod String, % of each size					
					1 1/8	1	7/8	3/4	5/8	1/2
76	3.75	2.119	0.690×10^{-6}	1.047	—	—	82.3	17.7	—	—
77	All	2.224	0.649×10^{-6}	1.000	—	—	100.0	—	—	—
85	1.06	1.883	0.873×10^{-6}	1.261	—	22.2	22.4	22.4	33.0	—
85	1.25	1.943	0.841×10^{-6}	1.253	—	23.9	24.2	24.3	27.6	—
85	1.50	2.039	0.791×10^{-6}	1.232	—	26.7	27.4	26.8	19.2	—
85	1.75	2.138	0.738×10^{-6}	1.201	—	29.6	30.4	29.5	10.5	—
86	1.06	2.058	0.742×10^{-6}	1.151	—	22.6	23.0	54.3	—	—
86	1.25	2.087	0.732×10^{-6}	1.156	—	24.3	24.5	51.2	—	—
86	1.50	2.133	0.717×10^{-6}	1.162	—	26.8	27.0	46.3	—	—
86	1.75	2.185	0.699×10^{-6}	1.164	—	29.4	30.0	40.6	—	—
86	2.00	2.247	0.679×10^{-6}	1.161	—	32.8	33.2	33.9	—	—
86	2.25	2.315	0.656×10^{-6}	1.153	—	36.9	36.0	27.1	—	—
86	2.50	2.385	0.633×10^{-6}	1.138	—	40.6	39.7	19.7	—	—
86	2.75	2.455	0.610×10^{-6}	1.119	—	44.5	43.3	12.2	—	—
87	1.06	2.390	0.612×10^{-6}	1.055	—	24.3	75.7	—	—	—
87	1.25	2.399	0.610×10^{-6}	1.058	—	25.7	74.3	—	—	—
87	1.50	2.413	0.607×10^{-6}	1.062	—	27.7	72.3	—	—	—
87	1.75	2.430	0.603×10^{-6}	1.066	—	30.3	69.7	—	—	—
87	2.00	2.450	0.598×10^{-6}	1.071	—	33.2	66.8	—	—	—
87	2.25	2.472	0.594×10^{-6}	1.075	—	36.4	63.6	—	—	—
87	2.50	2.496	0.588×10^{-6}	1.079	—	39.9	60.1	—	—	—
87	2.75	2.523	0.582×10^{-6}	1.082	—	43.9	56.1	—	—	—
87	3.25	2.575	0.570×10^{-6}	1.084	—	51.6	48.4	—	—	—
87	3.75	2.641	0.556×10^{-6}	1.078	—	61.2	38.8	—	—	—
87	4.75	2.793	0.522×10^{-6}	1.038	—	83.6	16.4	—	—	—
88	All	2.904	0.497×10^{-6}	1.000	—	100.0	—	—	—	—
96	1.06	2.382	0.670×10^{-6}	1.222	19.1	19.2	19.5	42.3	—	—
96	1.25	2.435	0.655×10^{-6}	1.224	20.5	20.5	20.7	38.3	—	—
96	1.50	2.511	0.633×10^{-6}	1.223	22.4	22.5	22.8	32.3	—	—
96	1.75	2.607	0.606×10^{-6}	1.213	24.8	25.1	25.1	25.1	—	—
96	2.00	2.703	0.578×10^{-6}	1.196	27.1	27.9	27.4	17.6	—	—
96	2.25	2.806	0.549×10^{-6}	1.172	29.6	30.7	29.8	9.8	—	—
97	1.06	2.645	0.568×10^{-6}	1.120	19.6	20.0	60.3	—	—	—
97	1.25	2.670	0.563×10^{-6}	1.124	20.8	21.2	58.0	—	—	—
97	1.50	2.707	0.556×10^{-6}	1.131	22.5	23.0	54.5	—	—	—
97	1.75	2.751	0.548×10^{-6}	1.137	24.5	25.0	50.4	—	—	—
97	2.00	2.801	0.538×10^{-6}	1.141	26.8	27.4	45.7	—	—	—
97	2.25	2.856	0.528×10^{-6}	1.143	29.4	30.2	40.4	—	—	—

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					1 1/8	1	7/8	3/4	5/8	1/2
97	2.50	2.921	0.515×10^{-6}	1.141	32.5	33.1	34.4	—	—	—
97	2.75	2.989	0.503×10^{-6}	1.135	36.1	35.3	28.6	—	—	—
97	3.25	3.132	0.475×10^{-6}	1.111	42.9	41.9	15.2	—	—	—
98	1.06	3.068	0.475×10^{-6}	1.043	21.2	78.8	—	—	—	—
98	1.25	3.076	0.474×10^{-6}	1.045	22.2	77.8	—	—	—	—
98	1.50	3.089	0.472×10^{-6}	1.048	23.8	76.2	—	—	—	—
98	1.75	3.103	0.470×10^{-6}	1.051	25.7	74.3	—	—	—	—
98	2.00	3.118	0.468×10^{-6}	1.055	27.7	72.3	—	—	—	—
98	2.25	3.137	0.465×10^{-6}	1.058	30.1	69.9	—	—	—	—
98	2.50	3.157	0.463×10^{-6}	1.062	32.7	67.3	—	—	—	—
98	2.75	3.180	0.460×10^{-6}	1.066	35.6	64.4	—	—	—	—
98	3.25	3.231	0.453×10^{-6}	1.071	42.2	57.8	—	—	—	—
98	3.75	3.289	0.445×10^{-6}	1.074	49.7	50.3	—	—	—	—
98	4.75	3.412	0.428×10^{-6}	1.064	65.7	34.3	—	—	—	—
99	All	3.676	0.393×10^{-6}	1.000	100.0	—	—	—	—	—
107	1.06	2.977	0.524×10^{-6}	1.184	16.9	16.8	17.1	49.1	—	—
107	1.25	3.019	0.517×10^{-6}	1.189	17.9	17.8	18.0	46.3	—	—
107	1.50	3.085	0.506×10^{-6}	1.195	19.4	19.2	19.5	41.9	—	—
107	1.75	3.158	0.494×10^{-6}	1.197	21.0	21.0	21.2	36.9	—	—
107	2.00	3.238	0.480×10^{-6}	1.195	22.7	22.8	23.1	31.4	—	—
107	2.25	3.336	0.464×10^{-6}	1.187	25.0	25.0	25.0	25.0	—	—
107	2.50	3.435	0.447×10^{-6}	1.174	26.9	27.7	27.1	18.2	—	—
107	2.75	3.537	0.430×10^{-6}	1.156	29.1	30.2	29.3	11.3	—	—
108	1.06	3.325	0.447×10^{-6}	1.097	17.3	17.8	64.9	—	—	—
108	1.25	3.345	0.445×10^{-6}	1.101	18.1	18.6	63.2	—	—	—
108	1.50	3.376	0.441×10^{-6}	1.106	19.4	19.9	60.7	—	—	—
108	1.75	3.411	0.437×10^{-6}	1.111	20.9	21.4	57.7	—	—	—
108	2.00	3.452	0.432×10^{-6}	1.117	22.6	23.0	54.3	—	—	—
108	2.25	3.498	0.427×10^{-6}	1.121	24.5	25.0	50.5	—	—	—
108	2.50	3.548	0.421×10^{-6}	1.124	26.5	27.2	46.3	—	—	—
108	2.75	3.603	0.415×10^{-6}	1.126	28.7	29.6	41.6	—	—	—
108	3.25	3.731	0.400×10^{-6}	1.123	34.6	33.9	31.6	—	—	—
108	3.75	3.873	0.383×10^{-6}	1.108	40.6	39.5	19.9	—	—	—
109	1.06	3.839	0.378×10^{-6}	1.035	18.9	81.1	—	—	—	—
109	1.25	3.845	0.378×10^{-6}	1.036	19.6	80.4	—	—	—	—
109	1.50	3.855	0.377×10^{-6}	1.038	20.7	79.3	—	—	—	—
109	1.75	3.867	0.376×10^{-6}	1.040	22.1	77.9	—	—	—	—
109	2.00	3.880	0.375×10^{-6}	1.043	23.7	76.3	—	—	—	—

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Table 4.1—Rod and Pump Data (See 4.5) (Continued)

1	2	3	4	5	6	7	8	9		
Rod No.	Plunger Diameter in. D	Rod Weight lb/ft W_r	Elastic Constant in./lb-ft E_r	Frequency Factor F_c	Rod String, % of each size					
					1 1/8	1	7/8	3/4	5/8	1/2
109	2.25	3.896	0.374×10^{-6}	1.046	25.4	74.6	—	—	—	—
109	2.50	3.911	0.372×10^{-6}	1.048	27.2	72.8	—	—	—	—
109	2.75	3.930	0.371×10^{-6}	1.051	29.4	70.6	—	—	—	—
109	3.25	3.971	0.367×10^{-6}	1.057	34.2	65.8	—	—	—	—
109	3.75	4.020	0.363×10^{-6}	1.063	39.9	60.1	—	—	—	—
109	4.75	4.120	0.354×10^{-6}	1.066	51.5	48.5	—	—	—	—
1010	All	4.538	0.318×10^{-6}	1.000	100.00	—	—	—	—	—

* Rod No. shown in first column refers to the largest and smallest rod size in eighths of an inch. For example, Rod No. 76 is a two-way taper of 7/8 and 6/8 rods. Rod No. 85 is a four-way taper of 8/8, 7/8, 6/8 and 5/8 rods. Rod No. 109 is a two-way taper of 1 1/4 and 1 1/8 rods. Rod No. 77 is a straight string of 7/8 rods, etc.

Table 4.2—Tubing Data

1	2	3	4	5
Tubing Size	Outside Diameter, in.	Inside Diameter, in.	Metal Area, sq. in.	Elastic Constant in./lb-ft E_t
1.900	1.900	1.610	0.800	0.500×10^{-6}
2 3/8	2.375	1.995	1.304	0.307×10^{-6}
2 7/8	2.875	2.441	1.812	0.221×10^{-6}
3 1/2	3.500	2.992	2.590	0.154×10^{-6}
4	4.000	3.476	3.077	0.130×10^{-6}
4 1/2	4.500	3.958	3.601	0.111×10^{-6}

Table 4.3—Sucker Rod Data

1	2	3	4
Rod Size	Metal Area Sq. in.	Rod Weight in air, lb/ft W_r	Elastic Constant, in./lb-ft E_r
1/2	0.196	0.72	1.990×10^{-6}
5/8	0.307	1.13	1.270×10^{-6}
3/4	0.442	1.63	0.883×10^{-6}
7/8	0.601	2.22	0.649×10^{-6}
1	0.785	2.90	0.497×10^{-6}
1 1/8	0.994	3.67	0.393×10^{-6}

Table 4.4—Pump Constants

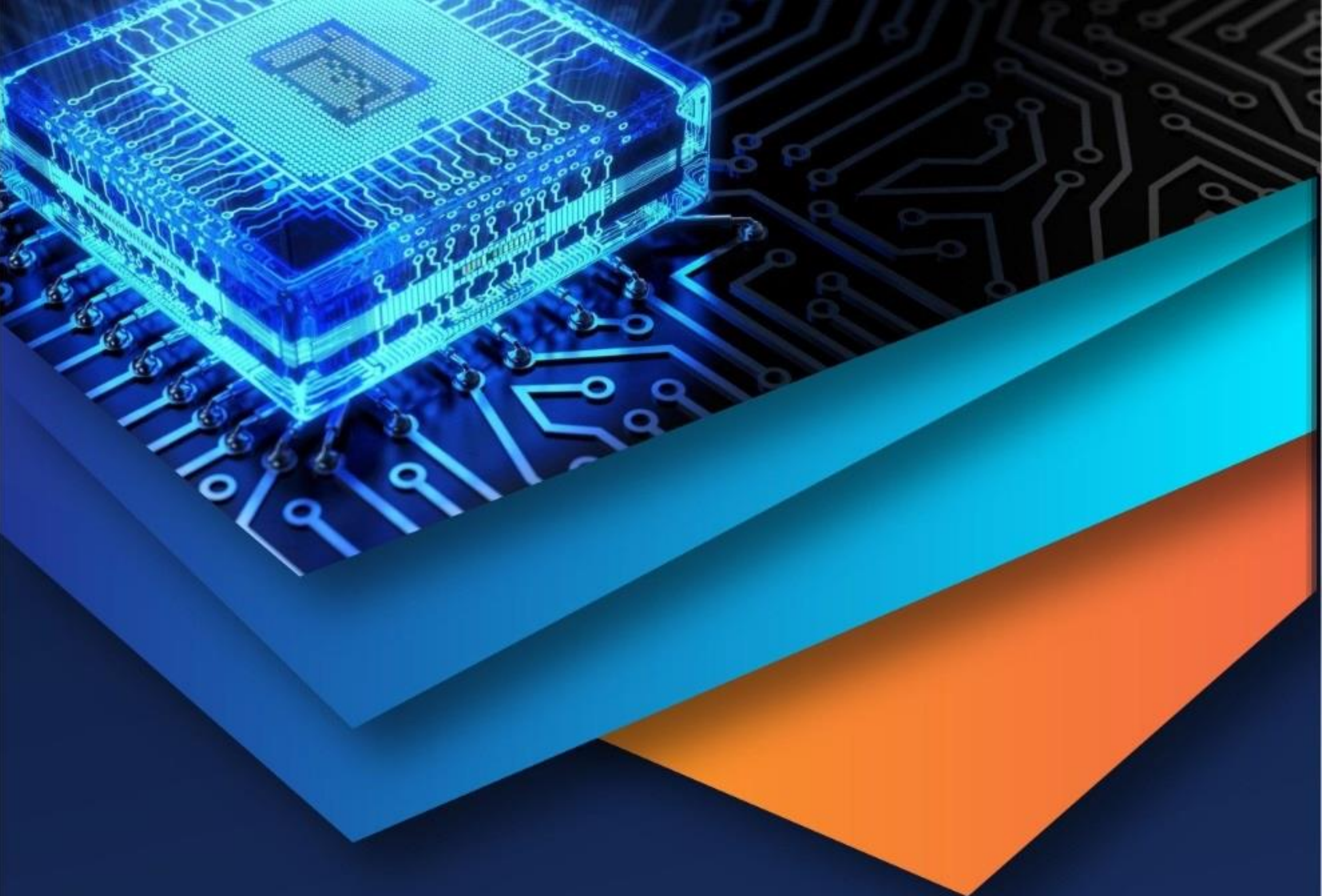
1	2	3	4
Plunger Diameter, in. *D*	Plgr. Diam, Squared Sq. in. D^2	Fluid Factor lb/ft $(.340 \times D^2)$	Load Pump Factor, $(.1166 \times D^2)$
1 1/16	1.1289	0.384	0.132
1 1/4	1.5625	0.531	0.182
1 1/2	2.2500	0.765	0.262
1 3/4	3.0625	1.041	0.357
2	4.0000	1.360	0.466
2 1/4	5.0625	1.721	0.590
2 1/2	6.2500	2.125	0.728
2 3/4	7.5625	2.571	0.881
3 3/4	14.0625	4.781	1.640
4 3/4	22.5625	7.671	2.630

V. CONCLUSION

Sucker Rod Pumping is one of the artificial lift method employed for lifting fluid. It is the simplest artificial lift method and is the most widely used choice of artificial method in the world. In the report we discussed about the working, problems and designing of Sucker Rod Pump system and also an attempt has been made to study and working on the designing of an SRP system with the help of a software named as GLIDE by solving the case studis by taking different calculations for a well.When a well produces with a certain quantity and stops producing as a normal well, then the well parameters are calculated and they are changed with the help of software named as GLIDE and the designing of SRP is changed according to the parameters of the output for the normal production of the well.

REFERENCES

[1] Design Calculations for sucker rod pumping system (conventional units), API Technical report 11L , Fifth Edition, June 2008.
[2] API Specification 11E, Seventh Edition ,November 1, 1994.
[3] API Specifications 11B, Specifications for Sucker rods, Polished rods and Liners, Couplings, Sinker bars, Polished rod clamps, Stuffing boxes and Pumping tees.Twenty Seventh Edition, May 2010.
[4] Beam Pumping: design and analysis by John J.Day and Joe P.Byrn.
[5] API Specifications 11AX, specifications for subsurface Sucker rod pump Assemblies, Components and Fittings, Thirteenth Edition (May 2015), API Monogram Program Effective Data: November 4, 2015.
[6] Lufkin engineering manual, Lufkin Foundry and machine co., Lufkin, Texas.



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