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Apply[Clear,Names["Global`*"]];
Off[General::spell];
Off[General::spell1];
d=160. 10^-3 ; (* m *)
R=d/2 ; (* m *)
n0=2400; (* rpm *)
n=n0/60.; (* rps *)
W=18000; (* N *)
"mu=9.75 mPa s"
mu=9.75*10^(-3); (* Pa s *)
"select P=1.5 MPa unit load for steam turbine"
P=1.5 10^6; (*Pa*)
L=W/(P d); (* m *)
Print["L=W/(P D)= ",L];
L=0.080;
"Select L=80 mm "
P=W/(d L);
Print["P= ",P," Pa"];
Smin=0.037;
Smax=0.35;

(* S=(R/c)^2 (mu n/P) *)
cf=R/(Smin P/(mu n))^0.5;
cl=R/(Smax P/(mu n))^0.5;
Print[" min. friction => c=",cf," m"];
Print[" max load => c=",cl," m"];

S1=0.762; H1=0.59; F1=16.; q1=4.3; qs1=0.56;
Smax=0.35; H1=0.425; F1=8.7; q1=4.8; qs1=0.72;
S2=0.140; H2=0.26; F2=4.4; q2=5.25; qs2=0.84;
S3=0.085; H3=0.195; F3=3.1; q3=5.45; qs3=0.88;
S4=0.041; H4=0.12; F4=1.9; q4=5.6 ; qs4=0.92 ;
Smin=0.037;Hf=0.11; Ff=1.75; qf=5.65; qsf=0.93;
S5=0.030; H5=0.1; F5=1.6; q5=5.7 ; qs5=0.94 ;

c1=R/(S1 P/(mu n))^0.5 ;
(* c1=R/(Smax P/(mu n))^0.5;*)
c2=R/(S2 P/(mu n))^0.5 ;
c3=R/(S3 P/(mu n))^0.5 ;
c4=R/(S4 P/(mu n))^0.5 ;
(* cf=R/(Smin P/(mu n))^0.5;*)
c5=R/(S5 P/(mu n))^0.5 ;

h1=c1 H1 ;
h1=c1 H1 ;
h2=c2 H2 ;
h3=c3 H3 ;
h4=c4 H4 ;
hf=cf Hf ;
h5=c5 H5 ;

ff=Ff cf/R;
f1=F1 c1/R;
f1=F1 c1/R;
f2=F2 c2/R;
f3=F3 c3/R;
f4=F4 c4/R;
f5=F5 c5/R;

c1m=c1 10^3;
c1m=c1 10^3;

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c2m=c2 10^3;
c3m=c3 10^3;
c4m=c4 10^3;
cfm=cf 10^3;
c5m=c5 10^3;

h1m=h1 10^3;
h1m=h1 10^3;
h2m=h2 10^3;
h3m=h3 10^3;
h4m=h4 10^3;
hfm=hf 10^3;
h5m=h5 10^3;

Print["c=",c1 , " S=",S1," h0=",h1," f=",f1];
Print["c=c1=",c1," S=Smax=",Smax," h0=",h1," f=",f1];
Print["c=",c2 , " S=",S2," h0=",h2," f=",f2];
Print["c=",c3 , " S=",S3," h0=",h3," f=",f3];
Print["c=",c4 , " S=",S4," h0=",h4," f=",f4];
Print["c=cf=",cf," S=Smin=",Smin," h0=",hf," f=",ff];
Print["c=",c5 , " S=",S5," h0=",h5," f=",f5];

Print["c[mm]          S          h[mm]          f"];
Print[c1m,"          ",S1,"          ",h1m,"          ",f1];
Print[c1m,"          ",Smax,"          ",h1m,"          ",f1];
Print[c2m,"          ",S2,"          ",h2m,"          ",f2];
Print[c3m,"          ",S3,"          ",h3m,"          ",f3];
Print[c4m,"          ",S4,"          ",h4m,"          ",f4];
Print[cfm,"          ",Smin,"          ",hfm,"          ",ff];
Print[c5m,"          ",S5,"          ",h5m,"          ",f5];

g1=ListPlot[10^3{{c1,h1},{c1,h1},{c2,h2},{c3,h3},{c4,h4},{cf,hf},{c5,h5}},
PlotJoined->True,
Axes->True,AxesOrigin->{0.03,0.02},PlotRange->{{0.03,0.25},{0.02,0.032}},AxesLabel->
{"c","ho"}, GridLines->{{c1m},{h1m}}];
g2=ListPlot[{{c1m,f1},{c1m,f1},{c2m,f2},{c3m,f3},{c4m,f4},{cfm,ff},{c5m,f5}},
PlotJoined->True,
Axes->True,AxesOrigin->{0.03,0.004},PlotRange->{{0.03,0.25},{0.004,0.0099}},AxesLabel->
{"c","f"}, GridLines->{{cfm},{ff}}];

homin=0.005+0.00004 d 10^3;
Print[" homin = 0.005+0.00004 D = ",homin," mm"];
"extreme case c=0.243237 mm =>"
Cs=2;
S=(R/c5)^2 (mu n/(Cs P));
Print["S=",S];
" from figure => h0/c=0.06"
hos=0.06 c5;
Print[" ho = 0.06 c = ",hos 10^3," mm > homin "];
"friction torque for tightest bearing fit"
" c=0.0482629 f=0.00965258"
Tf=W f1 d/2;
Print["Tf = W f d/2 = ",Tf," N m"];
FP=n0 Tf/9549;
Print["friction power = n[rpm] Tf[N m]/9549 = ",FP," kW"];

mu=9.75 mPa s

select P=1.5 MPa unit load for steam turbine

L=W/(P D)= 0.075

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Select L=80 mm

P= 1.40625 × 10⁶ Pa

min. friction => c=0.000219023 m

max load => c=0.0000712126 m

c=0.0000482629 S=0.762 h0=0.0000284751 f=0.00965258

c=c1=0.0000712126 S=Smax=0.35 h0=0.0000302654 f=0.00774437

c=0.000112597 S=0.14 h0=0.0000292752 f=0.00619284

c=0.000144505 S=0.085 h0=0.0000281784 f=0.00559955

c=0.000208065 S=0.041 h0=0.0000249678 f=0.00494154

c=cf=0.000219023 S=Smin=0.037 h0=0.0000240926 f=0.00479113

c=0.000243237 S=0.03 h0=0.0000243237 f=0.00486475

c[mm] S h[mm] f

0.0482629 0.762 0.0284751 0.00965258

0.0712126 0.35 0.0302654 0.00774437

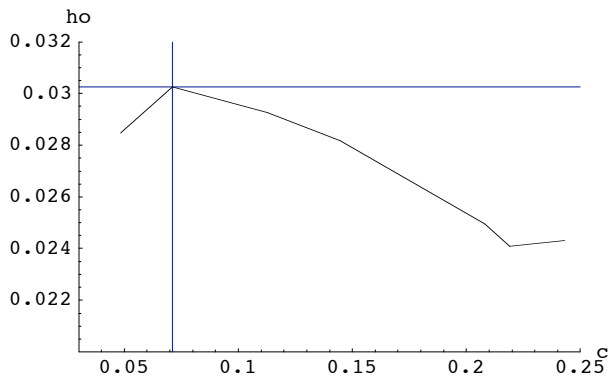
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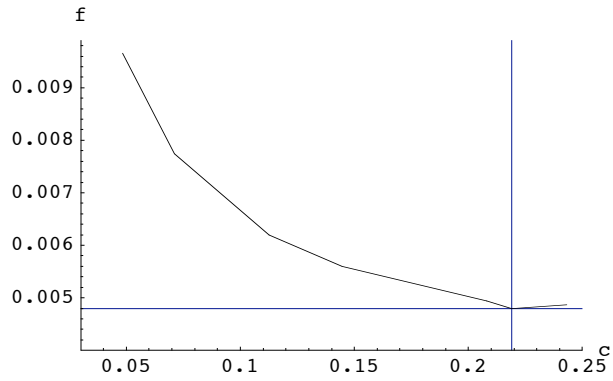
0.144505 0.085 0.0281784 0.00559955

0.208065 0.041 0.0249678 0.00494154

0.219023 0.037 0.0240926 0.00479113

0.243237 0.03 0.0243237 0.00486475





$h_{\min} = 0.005 + 0.00004 D = 0.0114 \text{ mm}$

extreme case $c = 0.243237 \text{ mm} \Rightarrow$

$s = 0.015$

from figure $\Rightarrow h_0/c = 0.06$

$h_0 = 0.06 c = 0.0145942 \text{ mm} > h_{\min}$

friction torque for tightest bearing fit

$c = 0.0482629 \quad f = 0.00965258$

$T_f = W f d/2 = 13.8997 \text{ N m}$

friction power = $n[\text{rpm}] \quad T_f[\text{N m}]/9549 = 3.49349 \text{ kW}$