Scholars Journal of Engineering and Technology

OPEN ACCESS

Abbreviated Key Title: Sch J Eng Tech
ISSN 2347-9523 (Print) | ISSN 2321-435X (Online)
Journal homepage: https://saspublishers.com

The Modeling of Power and Parameters on Wheel Hub for Motor in Forging Process

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DOI: 10.36347/sjet.2021.v09i06.002 | **Received:** 26.05.2021 | **Accepted:** 27.06.2021 | **Published:** 04.07.2021

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Abstract **Review Article**

With the increasing diameter and stress the power applied to motor wheel may increase in proportional, which means the big power will be formed in forge process of motor. Furthermore with increasing height and rotation it may increase as well. So that through power equation to be established the properties may be designed and checked before made. Detail value is needed to calculate the hub power according to the curves between them. The stress of hub is the first factor to consider and then its diameter and height which is second factor. The bigger power is 12KW and 35KW when rotation is 10r/m and height is from 350mm to 150mm respectively. That means that in the scope of this field the power may be bigger enough. When continuing to incline height the power will no change. The time increases as diameter and height inclines. The time will incline as the rotation declines.

Keywords: modeling; hub; power; parameter; motor; forge process.

1. INTRODUCTION

The wheel hub in motor has been made with forging press which applies to automobile so it is important part in factory and its modeling research may have significant as well. Since the material is huger than usual part the pressure value is big too. In General motor the forging workshop is independent one with cast one so that it is main division to produce hub [1-5]. Due to its huge one the processing and modeling may be difficult. The huge machine has several meters high furthermore the feeding and picking off is automatic in flow line.

In this study it is searched that the power which applies to motor. The diameter and height is first factor whilst pressure and rotation is the second factor to consider. The four parameters may be investigated in detail and look forwards to finding intrinsic relationship between them. The turn is investigated as well to affect them. For the sake of finding one it is constant with others so the value between them is distinguished. In this way the intrinsic relationship has been found and discussed in detail as below. The most important parameter is known and second and third & fourth one is needed to know.

In general all the parameters are searched in order to investigate the natural attribution. As for the design engineer it is benefit to the cost decrease. For example the fitted power is main looked for it is needed that the transparent and logical is necessary in the course of Modeling. So that the reasonable and precise value is the key though there is some little problem. The value may be objective and no fatal one it may do to use. The course is gradually approaching the virtual and fact. It is known that the quantity may make the quality.

2. MODELING FOR HUB

The power for wheel hub used to motor tire is established according to below equations. From raw materials the force is solved and then the power is calculated. The condition has a certain field which is for the comparison between these parameters. Total five parameters is investigated here and time is another sixth one to discuss.

From force defining it has [1]

$dF/dA=\sigma$ ---(1)

$dF = dA\sigma = \pi d(d^2)\sigma/4$ ---(2)

$dP = Fd(l/t)$ ---(3)

Because

$dv=2\pi dnR/60$ ---(4)

And $dt=dl/v$ ---(5)

So $dt=60l/(2\pi dnR)$ ---(6)

Here F is force; P is power; A is area; σ is stress; d is diameter; l is height; n is rotation; v is press speed; t is time; R is the rod radius. In Figure 1 the graph is shown, left is raw materials and right is formed product. Their value is shown in it. As seen in Table 1 the parameter in hub process is shown. [6]

Table-1: The criterion parameter and value in press for wheel hub of motor

Parameters / value	l /cm	l_1 /cm	d/cm	d_1/cm	d_2/cm
-	30	5	5	20	15

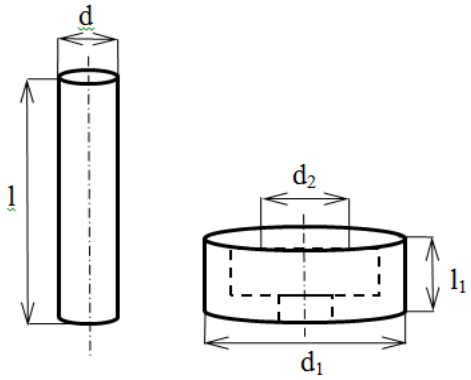
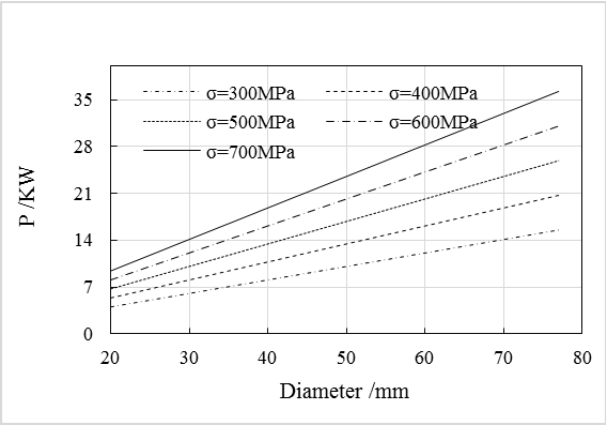


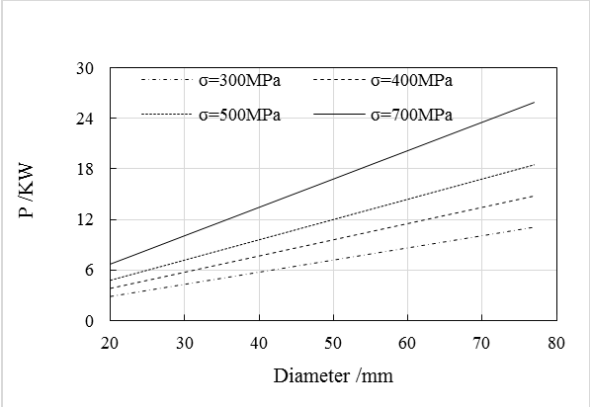
Fig-1: The schematic of wheel hub before (left) and after (right) forging press.

3. DISCUSSIONS

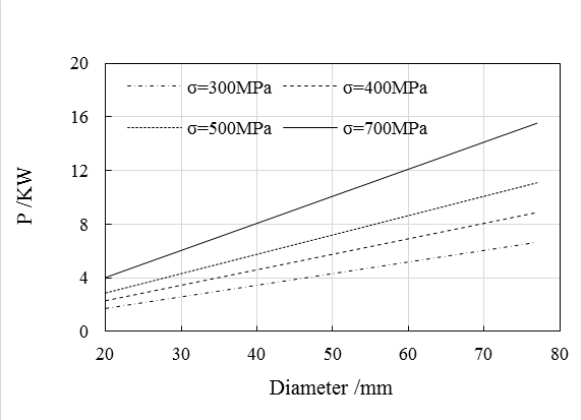
According to the above equations and modeling the power and parameters has been established as below figures. Firstly the power is solved and the time is calculated secondly. The power may increase when the diameter, stress and height increase in 8r/m as seen in Figure 2(a-c). They are in proportional linear. From Figure 2 &3 (a-c) it is known that it will decrease when the rotation declines from 8r/m to 6r/m. So there is four parameters may be relate to the power. That the stress is 500MPa is the fit one for cost decrease that attains 25KW when the diameter is 70mm and height is 350mm. The line becomes steeper when diameter is big and stress is big too.



(a) H=350mm



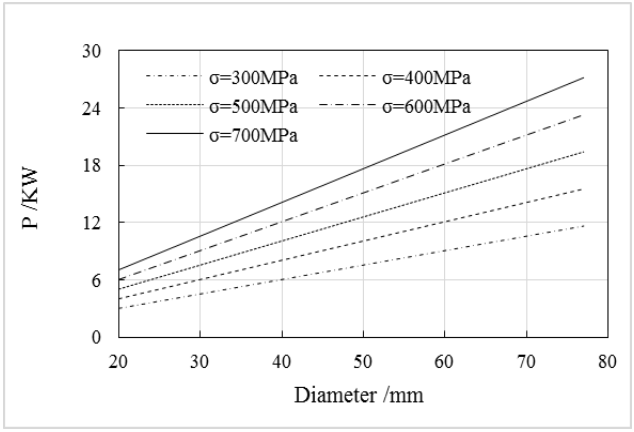
(b) H=250mm



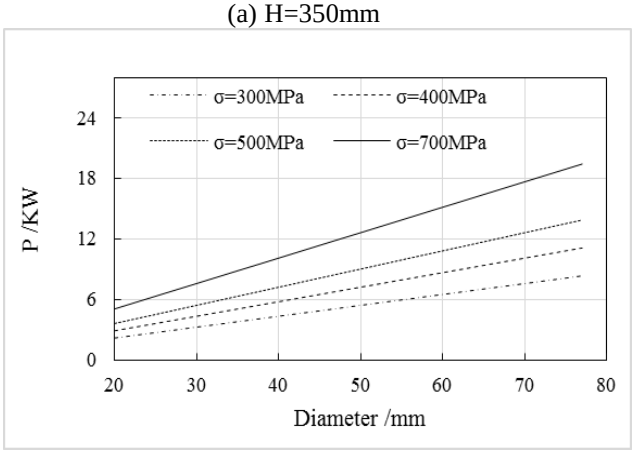
(c) H=150mm

Fig-2: The drawing between power and diameter &length with strength and diameter at 8 r/m for hub in forging process.

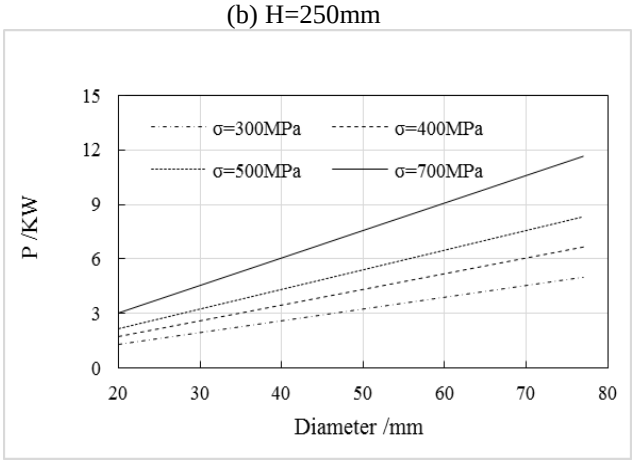
From Figure 4 it is known that with the declining stress from 700MPa to 300MPa the force may decline whilst it maintains a constant when the height inclines. With the declining diameter from 50mm to 30mm the force will decline from 24KW to 9KW too with the height from 170mm to 570mm under 300MPa. This is strange since the height may incline the power however the condition is sophisticate so it is chosen for balance. As for considering height the calculation is staying parallel form here that explains the status is difficult to gain. Because the height will increase power in above discussion it is not exhibited this trend. So the value with the stress is defined only and that power is bigger in high stress. The same situation happens with diameter.



(a) H=350mm



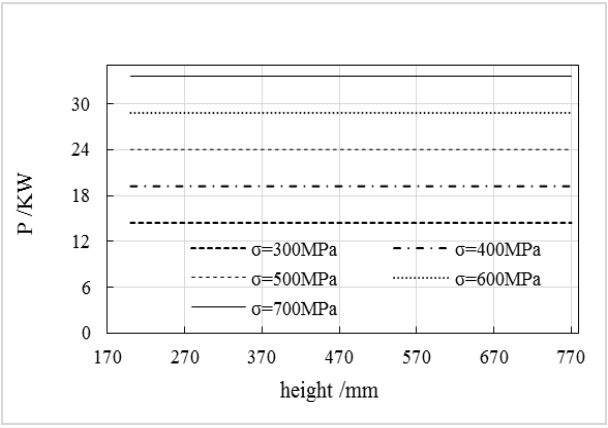
(b) H=250mm



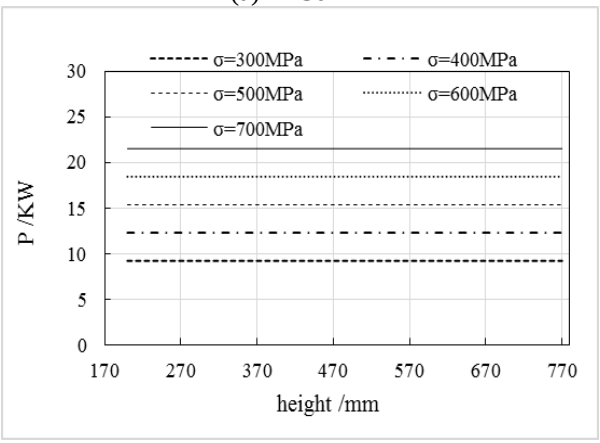
(c) H=150mm

Fig-3: The drawing between power and diameter &length with strength and length at 6 r/m for hub in forging press.

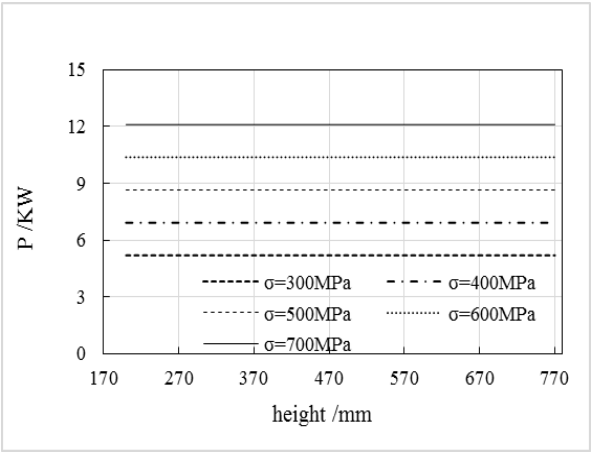
The power will decrease as the height becomes low and stress is low too. For example the lowest one happens at 150mm and 300MPa as seen in Figure 3(c). The fit one is 300MPa with the height of 1.5cm and diameter of 50mm and the power is 3KW. Another one is 400MPa with the same size as the former and it is 5KW which is better than the former since its high power that increases capacity to work further. As the same way the Figure 3(a~b) has high low cost value with its height.



(a) D=50mm



(b) D=40mm



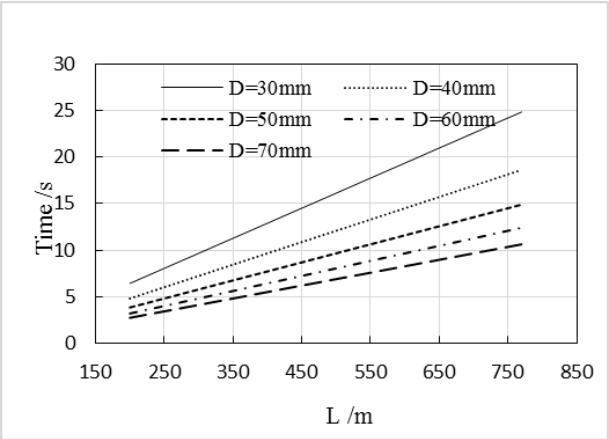
(c) D=30mm

Fig-4: The drawing between power and length & diameter with strength and diameter at 6 r/m in forging process.

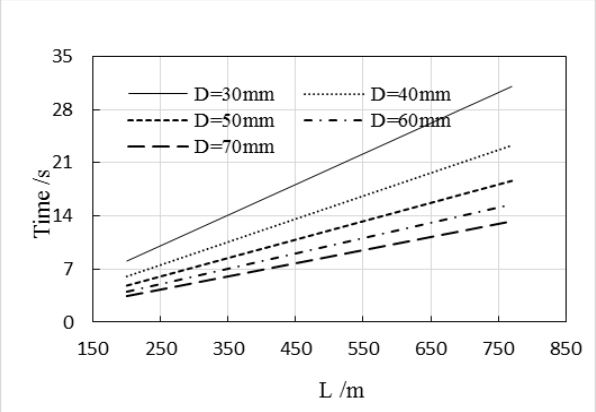
As seen in Figure 5(a-d) the time may decline with the declining height and decreasing diameter whilst with the declining the rotation it may incline too in terms of this study. All of these can fit to equation very well. The time may be 4s and 15s with height being 170mm and 750mm respectively under diameter of 50mm. It can be known that the precise value before manufacture so it is applied to design engineer to confirm the work time with the height and diameter &

stress. It is 10KW when the rotation declines to 4r/m under 50mm diameter.

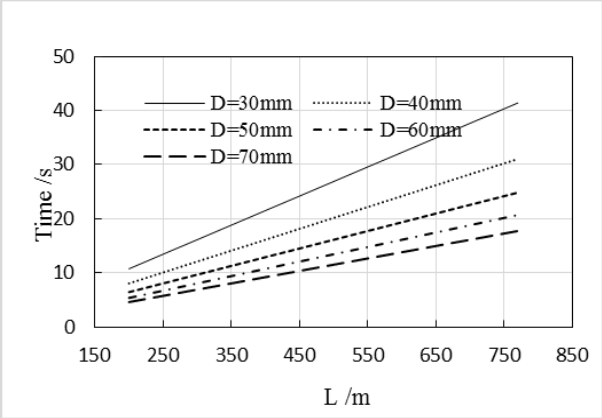
In general the power is affected with diameter, height and stress which must be higher than the yield stress because of its formed capacity. So we must check manual to ensure the normal value of yield one. If the applied stress doesn't meet this value the form is not proceeded. We elect some value to simulate its course to ensure the reasonable value for the low cost destination. On the other side the hub fatigue properties are important parameter to its use safely. The simulation about it will be proceeded simultaneously best that is necessary for further checking model. From the crack length using Paris equation $da/dN=C(\Delta K)^m$ to calculate the da/dN with ΔK for further investigating crack length. Here C is material feature parameter; m is constant; .ΔK is intensity factor. This will predict the material life for the evaluating the one regulate. Only if the qualified one go through customer application and in advance the experimental evaluation is needed as for the strict experiment. If customer needs it we can give the result to consider the deep reason. Because the hub is important part the specification as to its experiment and modeling data is needed as rapidly as possible. Because customer need its related materials we can excuse them for proof.



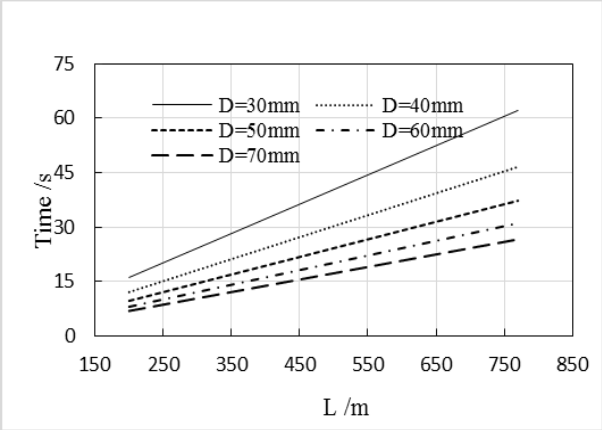
(a) n=10r/m



(b) n=8r/m



(c) n=6r/m



(d) n=4r/m

Fig-5: The drawing between time and length & diameter with rotation in forging process.

In short the force and time has been discussed in this paper. For the decreasing cost the value should be chosen carefully to avoid two terminals so the capacity and material fee should be in mediate status. The best case is has high capacity whilst the material cost is low. How to realize them are our utmost destination currently and in the future. If it is studied efficiently the power and time will be known by us from the view of cost lower. It is needed that it can be compared with the experimental data so the reasonable cost value will be formed by us not only modeling but also experiment. We can rapidly find the matter like wrong conditions and cost higher. Not only machine but also mold is needed to search to find and look for the main reason and other ones. If we proceed to predict to grasp some detail one it may be out of problem but it may be measured.

4. CONCLUSIONS

The force of hub may increase when the stress, rotation, diameter and height increase. The times for working will decrease when the rotation and diameter increase that may determine factor for design and evaluation. For the low cost the fit one will be chosen that means we shall avoid maximum and minimum one that has little capacity. The time inclines when the diameter and height increases and it declines when the

rotation increases. As the rotation is big the time declines meantime.

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