

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.705.294>

Efficacy of Base Condition on Pump Performance

R.N. Shrivastava*, M.K. Awasthi and R.K. Nema

Department of Soil and Water Engineering, College of Agricultural Engineering,
JNKVV Jabalpur, India

*Corresponding author

ABSTRACT

Keywords

Irrigation system,
Pump efficiency,
Pump foundation,
Suction lift

Article Info

Accepted:
18 April 2018
Available Online:
10 May 2018

Pump is the vital part of a irrigation system with the enhancement of irrigation pump population is increasing at a rapid rate but the operating efficiency is not taken care. Majority of the pumpsets are being operated at a poor efficiency of 20-30%. Causes of this poor performance are improper selection of pump, poor foundation, poor maintenance and excessive suction lift. Out of these four poor foundation is found in almost all pumps ie it is not any considerable point for the users. In order to understand the effect of various common foundations used by farmers present study was conducted. Six foundation conditions ie R.C.C. foundation, Wooden Rafter, M.S Channel, Hanging pump set with the help of chain, No foundation (No foundation) and Loose bricks were created in the laboratory and same unit was tested on each of them. Performance in terms of efficiency was evaluated. R.C.C. foundation gave maximum efficiency and loose bricks minimum.

Introduction

Increasing population and squeezing land, forced the man kind to grow more grain. Irrigation proved as a magical input to achieve this goal and farmers of the state even the tribal people have also been acquainted with the enhanced remunerations due to irrigation. Irrigation is given either through gravity flow or irrigation pumps. In present scenario about 66% of irrigation in the state is through ground water *i.e.*, through pumps besides this, irrigation from tanks, streams and even from canals also requires pump. This all has brought the number of pump set very high and at the same time, increasing electrification, credit facility through cooperative societies

and banks and policies of government created a favorable atmosphere. The use of electric pump sets took a rapid pace. Later the double and triple cropping and increasing tendency of taking cash crops like sugarcane etc. made this growth faster. This fact is evident from the statistics of Irrigation pumps.

All sort of pump needs energy for their operation, which is always a scarce commodity. Therefore efficient use of energy is the need of the time. It may be called one of the prime conditions of the sustainable development. Agriculture sector consumes about 30% of the energy utilization in the country. Energy required for pumping water for irrigation is an important component of the

total input in agriculture. Irrigation activity alone consumes about 40% of the energy used in agriculture.

The state of Madhya Pradesh is having a considerable share in the aforesaid national scenario. The number of electrical pump sets in 1951-52 was 2186, which is now becoming two billions approximately and consumes more than 10% of state's total energy. Thus, this huge pump population consumes a considerable amount of energy, an invaluable and rare but essential commodity. On the other hand efficiency of these pump-sets is very poor. As reported by many researchers, regarding performance of pumping unit in the farmer's field, it has been established that more than 50% of centrifugal pumps are operating at lower efficiencies to the extent of 20-30%. This is causing drain of energy and financial burden to the farmers.

As reported by Nema *et al.*, (2005), mainly four causes of the poor efficiency were identified as improper selection of pump, excessive suction lift, poor foundation and poor maintenance were found major causes of lowering the efficiency of pumps. These causes and their extent are as follows.

It is clearly depicted from the table 1 that 84% pump-sets are having poor foundation. Actually the improper selection of pumps, poor foundation and poor maintenance are the factors, which can be controlled with little awareness and attention. Farmers have no consideration for foundation. They just put the unit and run it as depicted from the pictures given below.

Materials and Methods

Thus has been found that base condition has a considerable effect on the performance of the pump and being ignored. Therefore, to observe the pump performance in various

foundation conditions and their suitability to pump was conducted as a lab study. In order to quantify effect of foundation various base conditions commonly observed in the farmers' field were selected for this study and simulated in the laboratory. Using a centrifugal pump of 5hp picked from farmers' field and keeping other condition similar the pump was tested on six various foundations namely

- R.C.C. foundation.
- Wooden Rafter.
- M.S Channel.
- Hanging pump set with the help of chain.
- No foundation (No foundation)
- Loose bricks.

Results and Discussion

R.C.C. foundation

This foundation was prepared as per the specifications. The unit was bolted with the help of nut and bolts. There was no vibrations during the operation discharge obtained was also good, it is 11.75 lps at a input power of 4.29 hp.

Wooden rafter

The unit was put and wound with the help of binding wire on wooden rafters. Discharge on this base was 11.52 lps. The power consumption of 4.31 hp was observed.

M.S. channel

The unit was put and wound with the help of binding wire on M.S. Channel. Almost no vibrations were felt. Discharge at this base

was 11.46 lps and power consumption as 4.31 hp was observed.

Hanging on the chain

The unit was hung through a chain and pulley system on a tripod. Though, the pump was hanging but after getting momentum in initial 20 min better stability was observed. Discharge was also little more. Discharge at this condition was 11.38 lps with power consumption of 4.34 hp.

No foundation: In this situation the pump was put on the ground. Vibrations were comparatively less as compared to loose brick platform. Discharge of 11.29 lps was observed with 4.37 hp power consumption.

Loose bricks: This base condition was prepared by putting loose bricks on each other on the ground. Maximum vibrations were felt and horizontality of the pump was also disturbed. Discharge of 10.83 lps and input power consumption of 4.45 hp were observed.

As the base condition (foundation) is a qualitative term it was not possible to establish

a relationship between various base conditions and efficiency. Pumping unit was graded as compared to an ideal pump foundation (Michael and Khepar, 1985). A well-maintained 5 hp electric motor pump-sets was tested for all the above conditions. Static suction and static delivery head were kept same for all the observations.

The results so obtained are presented in Table 2. It is clear from the table that maximum discharge of 11.75 lps was obtained on RCC foundation while the minimum was on loose bricks. It is depicted from the table as the stability of the base condition is reduced the same pump delivers lesser water, correspondingly the efficiency also reduced. This may be due to increased vibrations and disturbed horizontality and verticality. With the reduction in base quality, the same pump starts consuming more electrical energy. Thus, the pump becomes deficient. Efficiency of the unit dropped from 24.9% to 20.86% with the reduction in foundation quality. Thus a percentage reduction of 16.22% was observed from RCC foundation to loose bricks (Table 3).

Table.2 Performance of the unit at different base conditions

S. No	Foundation	Discharge (lit/sec)	Total head (m)	Input Power consumption (HP)	Efficiency (%)
1	RCC Foundation	11.75	6.82	4.29	24.9
2	Wooden Rafters	11.52	6.76	4.31	24.09
3	M.S. Channel	11.46	6.72	4.31	23.82
4	Hanging on chain	11.38	6.65	4.34	23.25
5	No Foundation	11.29	6.58	4.37	22.67
6	Loose bricks	10.83	6.43	4.45	20.86

Table.1 Causes of poor performance of pumping units

S. No.	Probable causes for poor performance	Percentage pumps
1	Improper selection of pump	75
2	Excessive static suction lift	53
3	Poor foundation	84
4	Poor maintenance	89

Table.3 Loss of efficiency on various base conditions

Foundation	Efficiency (%)	Percentage deviation (%)	Grading as compared to Ideal	Remark
R.C.C. Foundation	24.9	Base	10	Ideal
Wooden Rafter	24.09	3.25	9	Good
M.S. Channel	23.82	4.33	8	Good
Hanging chain on	23.25	6.63	6	Medium
No foundation	22.67	8.95	5	Medium
Loose Bricks	20.86	16.22	2	Poor

Table.4 Performance of the pump unit under varying heads.

Total head (m)	Discharge (lit/sec)	Rate of power consumption (hp)	Efficiency (%)
10.28	11.61	4.96	32.05
13.10	11.00	5.22	36.78
15.52	10.72	5.49	40.40
17.94	10.45	5.76	43.39
20.31	09.95	6.90	45.59
22.59	09.27	6.03	46.30
27.63	08.70	6.56	48.80
33.12	07.65	7.20	46.90
38.67	06.50	7.90	42.42



An attempt has been made to establish a relationship between grade of base condition allotted by sensory evaluation and efficiency of the unit. As the degree increased pump performed better. Observations on effect of base condition on power consumption clearly show that on better base the pump consumes less input power.

It was found during the above testing that with properly maintained pump and ideal foundation pump-set was resulted the maximum efficiency of 24.9% only with an appropriate suction lift. The observation draws the attention towards the suitability of the pump for the given conditions. Behind this in order to find out the reason father the pump picked from the farmers' field was tested on the *Pump Testing Rig*, under varying heads. The result of this test is presented in Table 4. It reveals that the efficiency varies from 23.25% to 48.8% with varying head. The unit gives best performance i.e. 44 to 48.8% efficiency at 22 m to 32 m head. It

indicates that the pump is designed for the head range 22-32 m. Previously, this particular pump was operated below 12.6 m and was giving poor performance. It was suggested to use this pump with sprinklers too up to a head of 27 m to get maximum efficiency of 49%..

Following conclusions are drawn from this

- R.C.C. foundation is most suitable foundation. As the degree of foundation decreases efficiency declines
- The pumping unit gives best performance i.e. 44 to 48.8% efficiency at 22 m to 32 m head.

References

Anonymous, 2005. Operational efficiency of irrigation pumps in farmers fields. AICRP on GWU, JNKVV, Jabalpur.

How to cite this article:

Shrivastava, R.N., M.K. Awasthi and Nema, R.K. 2018. Efficacy of Base Condition on Pump Performance. *Int.J.Curr.Microbiol.App.Sci*. 7(05): 2556-2560.
doi: <https://doi.org/10.20546/ijcmas.2018.705.294>