Vol. XVII & Issue No. 11 November - 2024
INDUSTRIAL ENGINEERING JOURNAL

# ENERGY EFFICIENCY ENHANCEMENT IN PUMPING SYSTEM TO BOOST NATION'S ECONOMY

**K L Mokariya**
Department of Electrical Engineering, Govt Engineering College Valsad, Gujarat.
Email: klmokariya@gecv.ac.in

**Krupa Gandhi**
Matrix Comsec Pvt. Ltd., Vadodara – 390 010, Gujarat.

**Snehal Patel**
Assistant Professor UkaTarsadia University, Gujarat, India

**Abstract**

*Agricultural sector is the dominant players while contributing GDP of the nation. Yet almost 70% of rural households in India still depend mainly on agriculture for their livelihood and 82% of farms are considered "small and marginal". Only 48% of the net sown area of country is irrigated. Out of land for irrigation 62% land of the country is by relatively deep water or tubular wells or other, more shallow types of wells. Most of these wells are electric or diesel pump. Paper mainly focuses on energy conservation aspects of pump including automation and control that enhances economy, reduces emissions.*

***Keywords: Economy, GDP, VFD, affinity laws, energy efficiency***

## INTRODUCTION

Variable Frequency Drives (VFDs) are used in a wide variety of applications, from small appliances to large coal-fired power plant drives, where significant energy savings can be achieved, properly selected and sized for energy savings, as well as suitable motors. It is used to regulate the speed of AC motors for applications that call for variable speed with variable torque [1],[2] such as conveyor speeds, blower speeds, pump speeds, machine tool speeds, and others. Almost 40% of the total energy consumed by indoor pools is consumed by the filter and circulation pumps, which are responsible for keeping the pool water clean. Booster pumps inevitably pressurize a commercial building's water supply when the mains water pressure is insufficient. A booster pump is necessary in many multi-story apartment buildings, hotels, and other buildings to maintain enough pressure in terminal units like showers and restrooms. Booster pumps can have a VFD installed in place of a pressure control valve. Energy is conserved, and maintenance expenses are cut out. The pharmaceutical industry consumes a significant amount of energy. During the course of its lifetime, even a basic air conditioner that costs a few hundred pounds is likely to consume tens of thousands of pounds of electricity[2]. By regulating the motor's speed, variable frequency drives contribute to significant energy savings. One of the best ways to save energy in the oil and gas sector is to use a VFD for a compressor. Reduced downtime because VFDs and motors require less maintenance than gas turbines. Most gas turbines are less efficient than VFD and motor, especially at part load. Gas turbines produce less electricity because air density decreases and less oxygen enters the combustion chambers, increasing the inlet air temperature. The VFD and motor are not affected by temperature. Choosing a VFD will be very useful for the refrigeration compressor. Because the chosen frequency converter with a very small size may have some drawbacks, extreme caution must be taken while choosing a variable frequency drive (VFD) to regulate the refrigeration compressor [3]. These situations can be avoided by using VFD selection software. Based on the individual process of selecting and qualifying the frequency converter suitable for a given refrigeration compressor, safe and energy-saving operation of the refrigeration compressor can be achieved. By offering variable speed pump operation, VFDs (variable frequency drives) are possible to achieve low current. As a result, the system pressure is decreased, and the pump is operating close to its maximum efficiency. The VFD has a number of unique software features that are necessary for safe crane operation. These make it easier to accomplish tasks like load spectrum calculations, rpm monitoring, or performance monitoring in field thinning operations (high speeds at part load). The crane's joystick, which has controls in the cab, can be connected to the variable frequency drive. For a long time, centrifugal fans, cooling tower fans, and AC motor speed controllers have all made extensive use of variable frequency drives.[4],[5]. Modern microprocessor-based control systems and cutting-edge compressor technology have allowed manufacturers to create frequency converters that are specifically made for centrifugal chillers. VFDs extend the life of the mechanical system and lower maintenance and upkeep expenses. Variable speed motors are more cost-effective than fixed speed motors and multi speed motors, according to a comparison of fixed speed motors (FSM) and variable speed motors (VSM) in [6].Although the passive filters in matrix converters and Active Front End (AFE) PWM drives are primarily used to filter the PWM frequency components, they are also a significant source of power loss because of the way they are set up to allow circulating currents to continue flowing even when the converter's main power source is turned off. When the primary component of the power system consists of several active front-end converters such as wind power generation units, solar inverters, or other general loads like oil jet pumps, this standby energy loss can represent a significant portion of the grid's overall energy waste. Input passive harmonic filters and output sine filters in uninterruptible power supply (UPS) systems use LCL or LC filters, which can also benefit the said technology. To save energy during periods of no-load operation, a technique of cutting off portions of the electrical circuit has been developed. This technique is particularly common in many regenerative power converters. The suggested circuit offers a way to reconfigure the circuit to accomplish the desired behavior when normal operation is desired, in response to a command from the master controller. To achieve compact dimensions and affordable dampening, the conduction loss of the switch might be combined with extra resistors [7]. The operations that take place when starting large motors cause the transients that have the biggest effects on the load nodes' operating conditions. The key concern when calculating such transients is system issues, such as figuring out the motor current during starting and if starting currents are acceptable from the standpoint of network operation. In order to overcome the resistance of the mechanism and produce a given quantity of kinetic energy in the rotational forces of the unit during starting, the motor must provide the torque required. When the motor is turned on, it consumes a significant percentage of the network's largely reactive current [8]. The load generation balance report from India suggests that even today we have power deficits in some parts of the country [9]. India's installed capacity is 377.26 GW [10], according to the India Summary of 31/01/2021. If energy saving practices are followed, this saved energy will be useful for more vehicles to enter the network. While we focus on energy savings in industries and villages, we can also use the saved energy to power vehicles. To save energy, a programmable logic controller (PLC) VFD and supervisory control and data acquisition (SCADA) system is implemented using an efficient and effective electromagnetic type flow meter. Energy conservation can be used to improve electric vehicle charging in India. Other benefits are listed below.

- Minimizes power line interruptions: Any voltage drop in power lines can adversely affect voltage-sensitive devices such as proximity switches, sensors and computers. Using a VFD eliminates voltage drop.

- Low starting power needed: Starting an AC motor online requires substantially more power than starting a VFD. Industrial consumers are likely to raise costs if they turn on these motors when energy consumption is high. However, this issue can be resolved because VFDs demand less beginning power.

- Assists in regulating operation speed and acceleration: Incremental performance improvement can greatly benefit applications like bottling lines that include tip-to-tip items. It turns slowly rather than abruptly at full power on the conveyor belt. Also, they provide a remote control so that you may manage the speed. For enterprises involved in the manufacturing of speed and acceleration, control is a tremendous advantage.

- Limits and adjusts torque: The AC motor shouldn't go over this limit because the inverter can limit and regulate the amount of torque. This safeguards the procedure or product and prevents damage to the equipment.

- Reduces costs and energy usage: A VFD that regulates a pump motor that typically operates at less than full speed uses less energy than a motor that runs at a steady speed for the same period of time. Moreover, it does away with the requirement for mechanical drive components, which also helps to reduce total expenses.

Additionally, if the irrigation pump is solar-powered, it has a number of obvious benefits [11] such as offering a distributed/grid end product, decreasing the need for heavily subsidized electricity for the agricultural sector will help ease the financial difficulties of distribution companies (DISCOMs), creating a positive alignment of solar irrigation time product, replacing subsidized imported diesel consumption with foreign currency and reducing current account wastage, and more.

The contribution of agriculture to the GDP ratio has decreased to roughly 10% as a result of the diversification of the Indian economy in recent years [12]. Nonetheless, 82% of farms are regarded as "small and marginal," while about 70% of rural households in India continue to rely primarily on agriculture [13]. In India, irrigation is typically necessary for successful agricultural. Just 48% of the nation's net cropland is irrigated; the remainder depends on erratic weather patterns. 62% of the land in the country is irrigated by tube wells, reasonably deep wells, or other shallower types of wells [14]. Most of these wells are powered by electricity or fuel. The table below [15] displays all of India's irrigation pumps.

**Table 1. Irrigation pumps in India**

| Sr No | Type | Million Units |
|---|---|---|
| 1 | Electrical Grid Connected | 21.00 |
| 2 | Powered by diesel pump | 8.80 |
| 3 | Powered by solar energy | 0.13 |

The decrease of 141 million tons of coal and 4 billion liters of diesel from a renewable energy target of 175 GW by 2022 (solar aim of 100 GW) will result in annual savings of INR 105 billion for coal fuel and INR 272 billion for diesel. Reducing the use of coal will lead to a reduction of 52.5 million tons of $CO_2$ emissions, while reducing the use of diesel will result in a reduction of 224 million tons of $CO_2$ emissions. Here is a discussion of centrifugal pump flow control techniques.

### 1. Impeller Diameter Change Effects

A change in impeller diameter indicates a proportional change in peripheral speed. Similar to the affinity laws, the variation of power with impeller diameter D is shown below.

$$Q \alpha D$$

$$H \alpha D^2$$

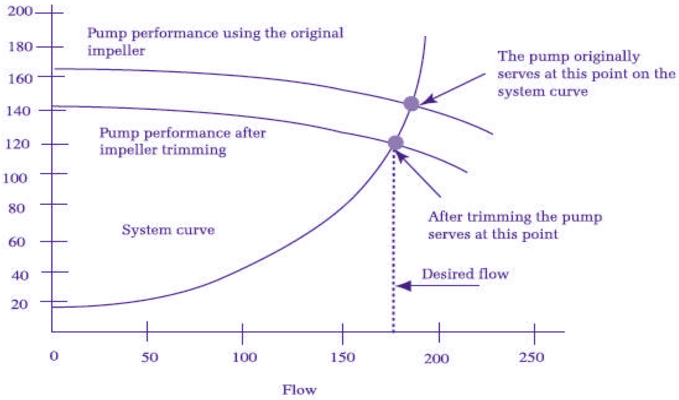
$$P \alpha D^3$$

By lowering the diameter to approximately 75% of the maximum, or lowering the head to about 50%, diameter variations are prevented. Efficiency and net positive suction head (NPSH) are severely impacted above this figure.

### 1.1. Impeller Trimming

Adjusting the impeller will be a useful correction of the pump when it is oversized due to an overly conservative design or changes in system load. Trimming the impeller reduces the tip speed, which in turn reduces the amount of energy transferred to the system fluid and reduces both the flow and the pressure generated by the pump. The effect of adjusting the impeller is shown in Figure 1 below.

**Figure 1. before and after impeller trimming [16]**




### 1.1. Pumps Switched on in Parallel Mode to Meet Demand

In situations when the static head is proportionate to the overall head, installing and running two or more pumps in parallel is a viable technique to manage flow. Replacing additional pumps enables adaptation to flow variance. The flow between two or three pumps is shown in Figure 2.

The quantity of pumps that are running has no impact on the system curve. Figure 3 demonstrates that as additional pumps are started for a system with a combination of static and frictional pressure drop, the operating pumps' performance curves move to higher head and, thus, lower flow per pump. The flow rate won't double when two pumps are operating compared to one. The flow rate would be proportional to the number of pumps running if the system head were just static. As long as their closed valve heads are comparable, pumps of various sizes can operate in parallel. A wide range of variable flow rates can be delivered to the system by setting up various combinations of pumps that are running simultaneously. It is crucial to make sure that the pump's operating point is kept within parameters that the manufacturer deems appropriate.

**Figure 2. Head-flow traces for parallel pumps [16]**

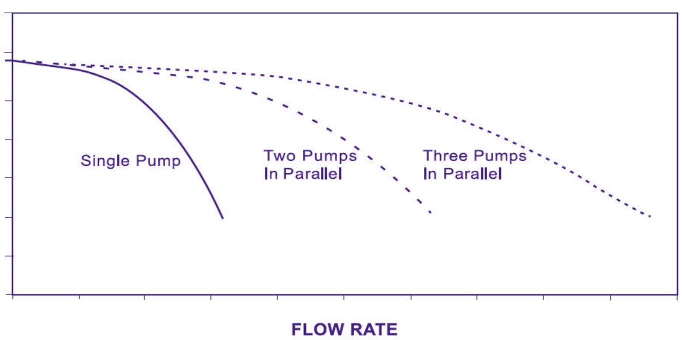
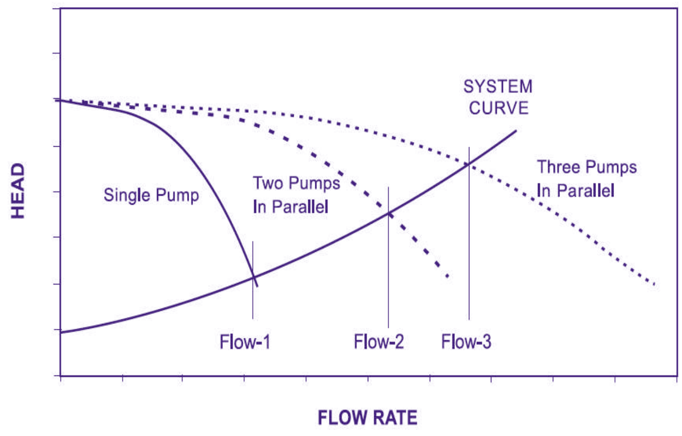



**Figure 3. Head-Flow curves for parallel-running pumps and system curves [16]**




### 1.1. Stop/Start Control

By turning the pumps on and off, the flow is managed using this technique. If stop/start control is required to reduce power consumption, it is best to pump at the lowest flow rate that the process permits because this reduces pipe friction losses and enables the installation of a decently sized pump. Pumping at half the flow rate for twice as long, for instance, can cut energy use in half. This indicates that running one pump continuously at full power is preferable to running two pumps simultaneously with stop/start control.

### 1.2. Bypass Control

When a permanent bypass line is attached to the outlet and bypass control access is granted, the pump will operate constantly at maximum process demand. Excess fluid is bypassed and returned to the power source when a reduced flow rate is needed. The little bypass pipe is not a flow control device, but it is required for secure pump operation in order to prevent the pump from operating at zero flow.

## 2. Variable Speed Drives

By slowing down the pump, less energy enters the liquid and requires bypassing or throttling. There are two primary methods for slowing down.

1. multi-speed motors
2. Variable speed drives

The aforementioned techniques directly regulate the performance of the pumps, while multi-speed motors and VSDs have fundamentally different uses. Because each motor speed requires a new set of windings, multi-speed motors are more expensive and less effective than single-speed motors. Moreover, easy discrete speed speed-changing is not an option for multi-speed motors.

The variable torque type load is the VFD's load characteristic. Pumps, blowers, and centrifugal fans are a few examples. A variable torque VFD can save a lot of energy when used

In these applications:

- The square of speed determines how much torque there is.

- Power is closely related to speed cubed.

The affinity laws are as follows:

$$\frac{Q_1}{Q_2} = \frac{N_1}{N_2} \qquad \frac{H_1}{H_2} = \left(\frac{N_1}{N_2}\right)^2 \qquad (1)$$

$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^3 \qquad \frac{Q_1}{Q_2} = \sqrt{\frac{H_1}{H_2}} \qquad (2)$$

Q is the flow rate (m3/min), N the speed (RPM), H the head (m), and P the power (horsepower).

Using the output formulae below, the pump output for a specific efficiency may be calculated once the flow rates and pressures are known.

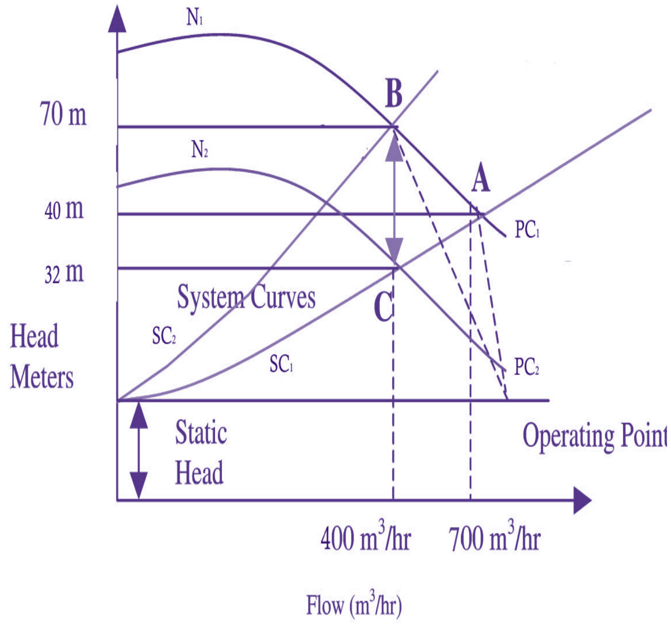
$$P = \frac{\rho\, g\, Q\, H}{\eta} \quad kW = \frac{P*0.745kW/HP}{\eta m}$$

This indicates that the required horsepower at half speed is roughly 1/8 of the rated maximum.

### 2.1. Methodology

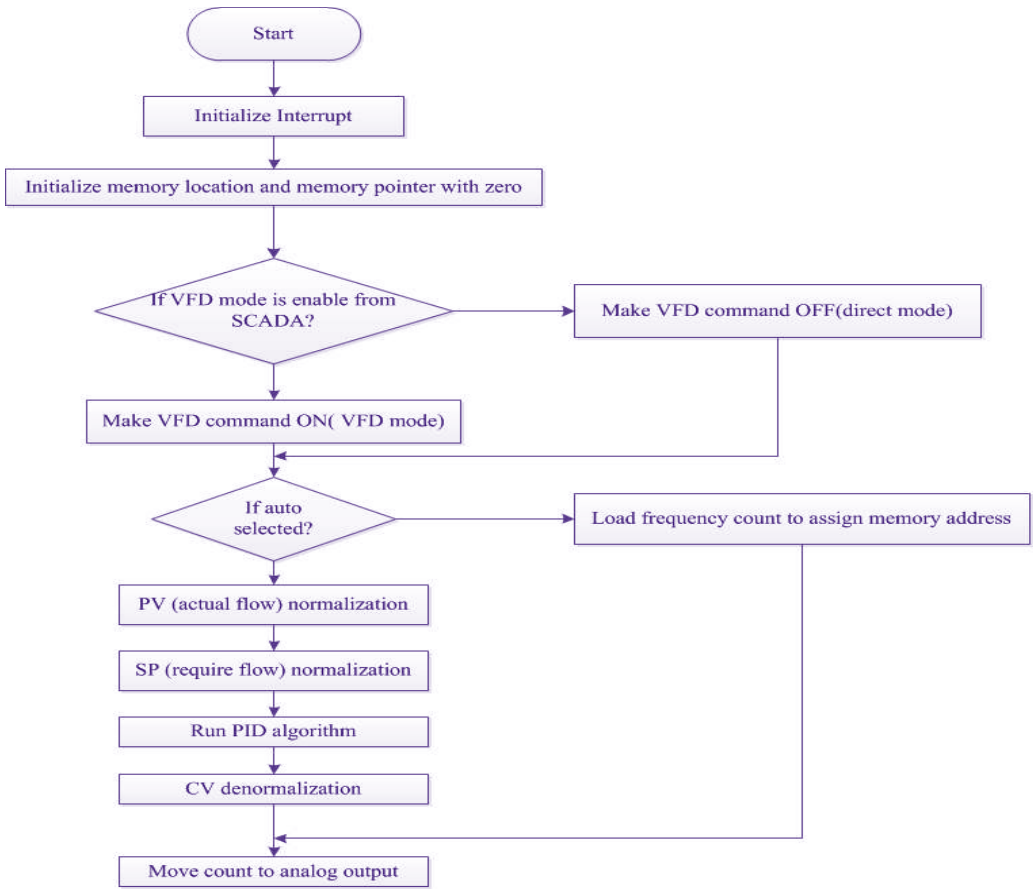
When not required, a variable frequency drive simply reduces the system's overall power. Take into account a system with a system curve like line SC1 in Figure 4. At operating point, A, where the head is 40 meters and the flow rate is 700 m3/hr, line PC1, the pump curve, intersects the system curve. Nevertheless, 400 m3/hour is the real flow requirement. Due to the artificial resistance created by closing the throttle valve, which raises the system curve above the primary, the flow can be lowered. The target flow rate of 400 m3/h is attained at the new operating point B, although at a higher head. The pump must consequently overcome an increased head (BC), which requires more electricity to power. As a result, controlling flow with a throttle valve is not always a good idea. The pump's best efficiency point (BEP), when the required flow and head are attained, is reached by reducing the speed from N1 to N2, at which point the pump curve goes below and intersects the original curve by a factor of C. On the first scan, the PLC software launches and instantly enters the initialization phase. A number of operations are carried out during this initialization, including activating and disabling particular control bits, choosing a mode, and defining memory addresses and high-speed counters. Direct or VFD mode selection is made possible by a control bit. The flow transmitter transmits the flow in L/h, which is received. 4000 l/h maximum flow rate. The signal is transformed to 0-32,000 pulses using a flow converter, then to 0-1, which is commonly utilized as a process variable, using a PID controller. Setpoint is the second value that the PID controller receives as input from the SCADA system. Normalization is the process of changing the signal from the actual flow rate to 0–1. The control variable is the output of the PID controller, which has a range of 0 to 1. Once more, 0-10V is applied to this signal before being delivered to the VFD. A 30ms timer will be used to obtain an average of 20 measurements and 02 counters, resulting in an updated total flow reading of 30 x 2 x 20 = 1200ms = 1.2s.

**Figure 4. Throttling VS VFD from flow VS Head Attributes Comparison [16]**




Closed-loop control combining a VFD with PLC and SCADA systems is seen in Figure 5. SCADA specifies the desired flow rate as constant points. From the SCADA system, the start/stop command can be entered. In both modes, SCADA offers the choice of direct mode or VFD mode. Moreover, two sub-modes—VFD mode, automated mode, and manual mode—can be chosen. Whereas in manual mode the frequency as the set point is entered to obtain the required flow rate, in automatic mode PLC adjusted the frequency and speed to deliver the desired flow rate, frequency as the set point in the manual mode in order to get the required flow rate. In automated mode, the flow sensor outputs a high-speed pulse in the 0–50 Hz band that represents the actual flow measurement. An average of 20 flow patterns were then provided to stabilize the variability of the resultant flow value after the PLC had received these high-speed pulses. The PID block of the PLC uses this value as a PV process variable as feedback while simultaneously receiving the necessary flow rate as a setpoint from the SCADA system. The PID block generates an error signal after comparing the measured flow to the predetermined value.The desired sort of reaction by modifying the relevant values of KP, Ti, and Td was achieved. In order to achieve the required output, the PID generates a control signal proportionate to the error signal and modifies the motor frequency using the VFD. The analogue output port of the PLC has a 0-10 V signal that serves as the control signal from the PLC to the VFD.The required communication between the PLC and the SCADA system was via a connection between RS485 (PLC side) and RS232 (PC side).

**Figure 5. VFD-PLC-SCADA operating flowchart**




**1. Test Setup**

Figure 6 displays a diagram of the test equipment. It has a ball valve, a magnetic flow metre, a manometer, a centrifugal pump, and a water tank. The following is a list of the parts specifications. The electromagnetic flowmeter's front appearance is depicted in Figure 7.

- **Pump Information (Crompton Greaves minimaster III)**
  - KW/hp : - 0.75/1.00
  - Head : - 6/45 m
  - Discharge : - 4000/900 lps
  - Pump Number : - KFPM06914
- **Flow meter**
  - Magnetic flow meter (ELMAG-200M)
- **HMI Panel (CVM-NRG96)**
- **PLC**
- **Siemens S7 200 PLC**

The reading is displayed in direct mode in Table 2.The reading reveals that the head has significantly risen in order to restrict the flow, which leads to higher energy usage.. Readings in VFD mode are shown in Table 3. Figure 8 makes it evident that, similar to the VFD mode, when the flow rate is decreased, the net head will also be decreased, leading to a decrease in power usage and an increase in energy efficiency. Figure 9 also explains the same.Figure 10 depicts the variation in speed per power and variation in speed per head for the VFD mode. The principles of affinity are further demonstrated by the enormous impact that speed reduction has on power usage. A comparison of flow and power for a VFD and direct mode application is shown in Figure 11.It explains VFDs for saving energy when it comes for flow control.

**Figure 6. Set up for flow control Implementation**

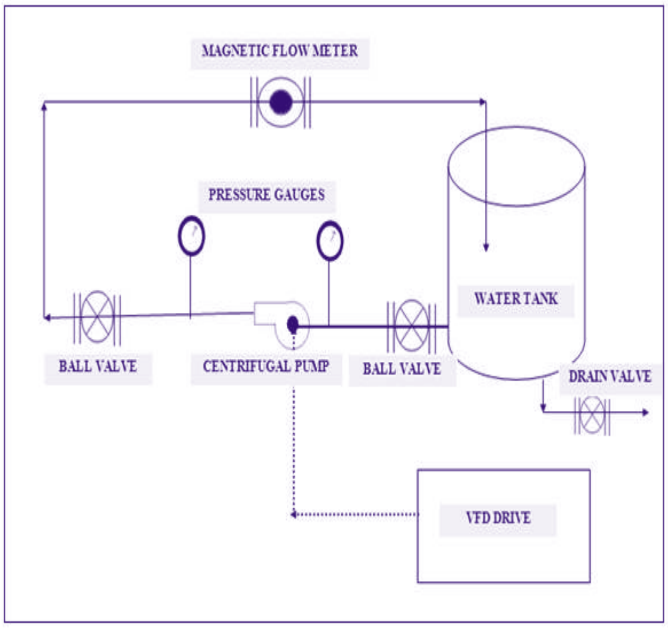


**Figure 7. Front view of Electromagnetic flow meter**

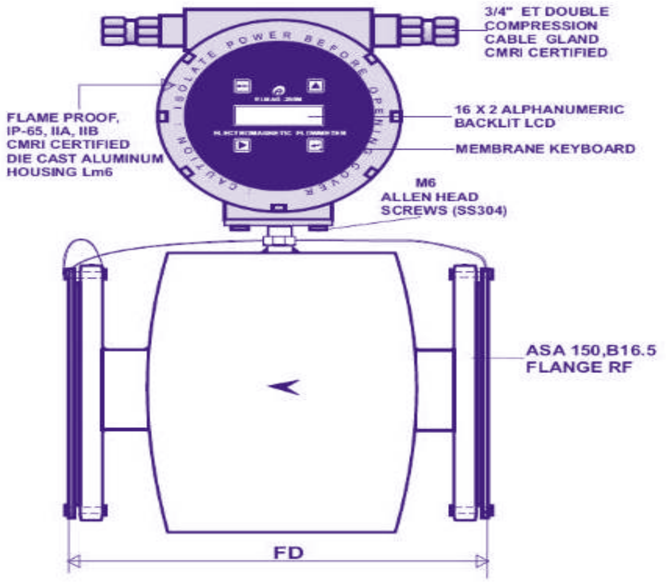



**Table 2. Readings with throttling**

| Sr. No. | Q $m^3/hr$ | H m | V volt | I Amp | KW (i) | KW (avg) | KV Ar (i) | KVAr (avg) | KVA | PF | %THD V | %THD A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.81 | 4.23 | 218 | 1.21 | 0.104 | 0.134 | 0.28 | 0.232 | 0.267 | 0.500 | 4.1 | 9.13 |
| 2 | 3.5 | 6.9523 | 216 | 1.64 | 0.126 | 0.155 | 0.29 | 0.243 | 0.288 | 0.536 | 4.1 | 9.9 |
| 3 | 3.21 | 10.1536 | 220 | 1.63 | 0.146 | 0.172 | 0.29 | 0.245 | 0.299 | 0.573 | 4.1 | 9.58 |
| 4 | 2.89 | 14.2547 | 221 | 1.63 | 0.156 | 0.181 | 0.29 | 0.246 | 0.305 | 0.594 | 3.93 | 8.3 |
| 5 | 2.5 | 20.3225 | 192 | 1.44 | 0.179 | 0.205 | 0.293 | 0.242 | 0.317 | 0.647 | 4.06 | 8.5 |
| 6 | 2.12 | 25.2479 | 222 | 1.48 | 0.207 | 0.232 | 0.293 | 0.240 | 0.334 | 0.694 | 4.06 | 8.5 |
| 7 | 1.51 | 34.0963 | 222 | 1.62 | 0.251 | 0.256 | 0.293 | 0.243 | 0.353 | 0.724 | 4.1 | 8.5 |

**Table 3. Readings with VFD**

| Sr.No | Q $m^3/hr$ | H m | V volt | I Amp | KW(i) | KW(avg) | KVAr(i) | KVAr(avg) | KVA | PF | %THD V | %THD A | RPM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.81 | 5.7719 | 221.8 | 0.93 | 0.101 | 0.141 | 0.079 | 0.033 | 0.145 | 0.973 | 3.833 | 68.46 | 2919 |
| 2 | 3.5 | 5.1055 | 221.3 | 0.77 | 0.084 | 0.118 | 0.066 | 0.027 | 0.121 | 0.974 | 3.933 | 66.16 | 2703 |
| 3 | 3.2 | 4.852 | 222.3 | 0.64 | 0.077 | 0.099 | 0.058 | 0.022 | 0.101 | 0.974 | 3.933 | 66.26 | 2465 |
| 4 | 2.9 | 4.112 | 222.8 | 0.51 | 0.071 | 0.082 | 0.042 | 0.016 | 0.083 | 0.980 | 3.833 | 66.26 | 2235 |
| 5 | 2.5 | 3.8996 | 220.23 | 0.43 | 0.059 | 0.065 | 0.032 | 0.012 | 0.066 | 0.983 | 3.966 | 67.13 | 1933 |
| 6 | 2.12 | 3.5542 | 224.6 | 0.35 | 0.045 | 0.052667 | 0.028 | 0.01 | 0.053608 | 0.982447 | 3.966 | 73.1 | 1632 |
| 7 | 1.51 | 3.0254 | 225.5 | 0.26 | 0.035 | 0.039 | 0.017 | 0.006 | 0.039459 | 0.988372 | 3.833 | 72.73 | 1172 |

**Figure 8 Flow VS Head for Throttling VS VFD**

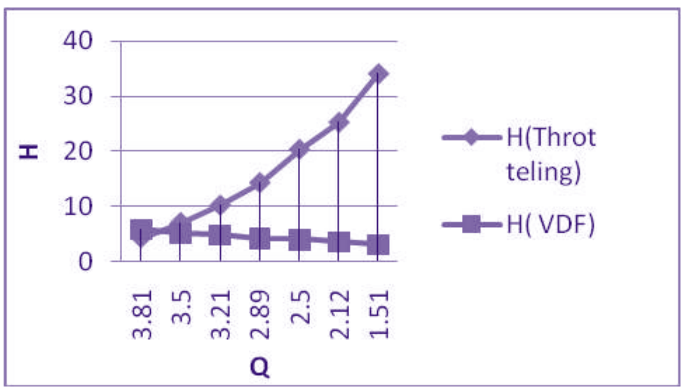



**Figure 9. Flow Vs Power (a) Throttling (b) VFD**

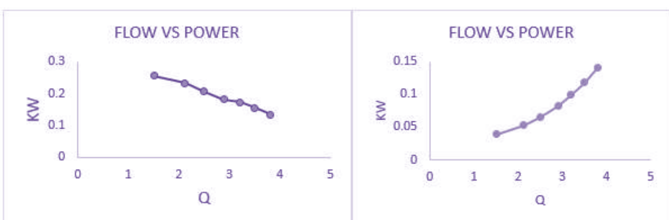



**Figure 10. VFD mode (a) Speed Vs Power, (b)Speed Vs Head**

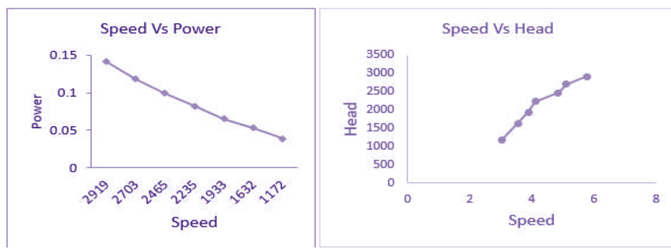
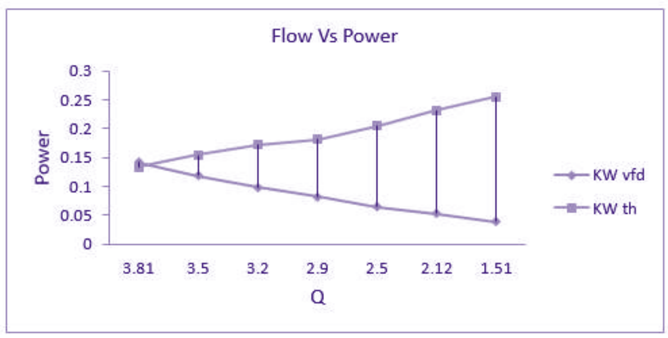


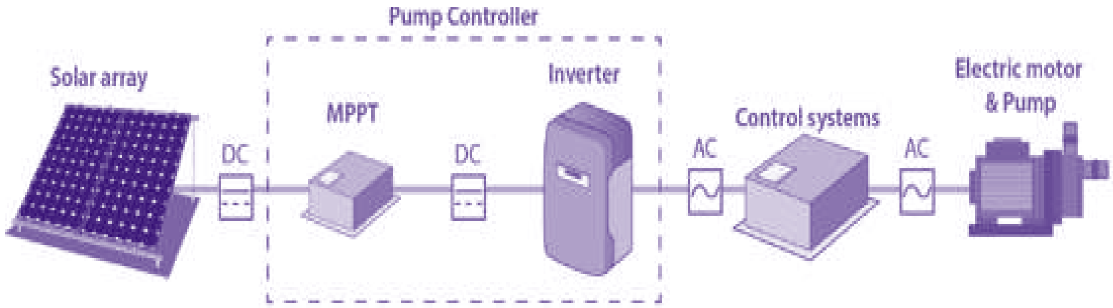

**Figure 11. Flow Vs Power Consumption Comparison of VFD Vs Throttling**



### 3.0 Solar Power Pump

A solar water pumping system is a cost-effective solution for irrigation pumps that run on electricity or diesel pumps. The water required for irrigation varies drastically by crop. If more water is needed during the agricultural season, these solar pumps will be an ideal choice. A solar photovoltaic pumping system is an ecological and low-maintenance option for pumping irrigation water, and when considering the possibilities of energy saving with reduced emissions, it will be one of the best solutions.

**Figure 12. Solar powered motor pump [17]**




### 3.1 Comparison between Solar and Diesel Pump

The detail Comparison is shown in Table 4 below.

**Table 4: Comparison between Solar and diesel pump**

| Parameters | Solar Pumping | Diesel pumping |
|---|---|---|
| Capital Cost | Due to initial cost of solar PV Panels, it has high Capital Cost | It has a low capital cost as compared to Solar Pumping system |
| Operation Cost | Low operating cost due to absence of moving parts. | A high operating cost to maintain proper working of diesel generator, Greenhouse gas emission and regular monitoring of diesel generator |
| Fuel cost | As solar energy is available in abundance this cost is nill | Very high. It is the prominent expenditure in diesel pumping during its operation. |
| Maintenance Cost | Solar pumping system has a low pumping cost because in normal operating conditions this type of plants requires normally cleaning and dusting. | In accounting for proper lubrication oil level, oil filter cleaning, wear in bearings and couplings. These components are regularly monitored as part of preventive maintenance program |
| Replacement Cost | In this type solar PV Panels has a projected life of 25 years and need not be replaced. The controlling unit has a 10 year life expectancy and need to be replaced once throughout solar water pumping system lifetime. | It has a life span of 10 years only and and whole diesel generator might be required to replace at least once in whole life span of diesel water pumping system. |
| Environment benefits | No negative effect on Environment. The end user will be benefited if there is provision of carbon tax credits. | While 1 liter of diesel is used approximately 2.7 kg of CO2 is released into an atmosphere. If lubrication oil or fuel spillage occurs It might potentially contaminate water supply |

**3.2 Planning and Choosing a Solar Water Pumping System**

The following summarizes the procedures in planning and choosing a solar water pumping system:

1. Steps to be followed during visit of the site of Installation

A. Identify the water source, then choose the ideal solar water pumping system to be installed based on the features of the water source and the water's intended use.

B. Establish the daily or weekly water needs and ensure that they can be met over the long-term using the available water resources.

C. Identify the location of solar array

D. Identify the location of the water pump.

E. Calculate the length of wires needed to connect the water pump, pump controller, and solar array.

F. Decide where and how you will keep the water stored.

G. Static head of the site has to be measured.

H. Measure the total distance from the water source to the final location of the water.

I. All land irregularities (hills, ditches, etc.) that the piping system must cross should be identified and measured.

2. Determine the annual and monthly sun irradiation for the place that was chosen.
3. Choose the type and size of the water pipe that will be used to move the water from the source to its storage tank, or, if there is no storage tank, to its eventual destination.
4. Calculate the anticipated dynamic head and choose a potential solar water pumping system, taking into account the available solar irradiation, using either manufacturers' tables or a suitable computer software or calculations. This will then reveal details about the maximum flow rate.
5. Calculate the frictional losses (flow friction head) using the anticipated maximum flow rate, then work out the dynamic head.
6. Pick a pump type that is compatible with both the site's general characteristics and the quality of the water being pumped, particularly the amount of mud or coral sand in the water.
7. Finalize the calculation's based on dynamic head finalized.

**CONCLUSION**

With a reduction in 141 million tons of coal and 4 billion liters of diesel, the government's goal of 175 GW of renewable energy by 2022 (with a solar target of 100 GW) will save INR 105 billion on coal and INR 272 billion on diesel annually. Reducing the use of coal will lead to a reduction of 52.5 million tons of $CO_2$ emissions, while reducing the use of diesel will result in a reduction of 224 million tons of $CO_2$ emissions. If the provided methods for flow management are used in villages, towns, and industries, the above values will be greatly attained. This excess energy saved can be used to charge more electric vehicles in India's power grid and reduce the gap between power generation and demand and improve the country's economy.

**ACKNOWLEDGEMENT**

I would like to thank my Ph.D. guide Dr. V.A Shah madam for motivating me and inspiring me always for research work and best research outcomes. I would also like to thank principal Government Engineering College Valsad Dr V S Purani Sir who is a source of motivation for carrying research work. The authors and coauthors would like to thank the students and faculties with whom they have interacted at their institute or outside institute in their carrier for best discussion and outcomes.

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