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Operate Drip Irrigation System Pumping Unit Using Multiple Energy Sources

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ABSTRACT

The experiment was conducted in the Desert Guide Way Farm which belongs to the Agricultural Extension Department / Agricultural Office in Karbala Government to investigate operating drip irrigation system pumping unit by using multi-power sources. Multi- power Sources with three levels including: pump with motor operated with charged battery by solar and wind power, pump with motor operated with internal combustion engine by bio fuel , pump with motor operated with internal combustion engine by natural fuel (gasoline) which represented main plot and discharge levels including 3.5 $m^3.h^{-1}$ and 1.8 $m^3.h^{-1}$ which represented sub plot were studied in this research. Water horse power, break horse power, pumping efficiency, operating costs, were measured in this experiment. Split plot arrangement under randomized complete block design (RCBD) with three replications was used in this experiment. The results showed that pump with motor operated with internal combustion engine by natural fuel (gasoline) treatment got higher brake horse power reached 0.238 hp mean while pump with motor operated with charged battery by solar and wind power treatment got the lowest operating costs reached 0.71 $/day also the results showed that discharge 3.5 $m^3.h^{-1}$ tertment got the highest water horse power reached 0.203 hp and brake horse power 0.289 hp and got the highest pumping efficiency stood 70.28% and the lowest operating cost stood 2.74 $/day. The interaction between the pump with motor operated with charged battery by solar and wind power with discharge 3.5 $m^3.h^{-1}$ treatment gave the highest water horse power stood 0.202 hp and pumping efficiency stood 70.72% and the lowest operating cost stood, 0.71 $ / day.

Introduction

The world turns to search for new and clean energy sources which characterized with Continuation and lowest possible cost to provide the growing need in developed and different life applications, whether on the farm level or industrial. Renewable energy sources do not need fuel or continuously maintain and this quality makes it the most suitable in desert which is to remote areas and away from the processing power centers where technicians are not available for maintenance and repair of diesel systems that need to conventional fuel to run them (Borzani et al., 1993) .

The energy economy is designed to extract the maximum amount of energy from primary sources while preserving the environment and reduce the damage to a minimum, and the best of those options are the most promising is to harness solar, wind and biomass for the production of electrical energy. Electricity is generated from renewable energy compete with electricity generated by known methods cost (www. arab-ency.com).

The availability of irrigation water is also a problem to reduce the acreage so resorted specialists to develop and use new methods to reduce losing water that the old methods of irrigation process accompanied by large losing water and with a severe shortage in the availability of the quantities of water in general and irrigation water in particular (Altief and Alhadithi , 1988).

The newly developed and efficient methods in which the efficiency of up to 95% to maintain the amount of water lost by evaporation and deep percolation from the water plant needs is the drip irrigation method (Hamman and Izuno, 1989). And the added amount of water in the form of drops connected to or disconnected from a network of pipes to the root zone through the use of a private drippers. This method works on the availability of adequate moisture for the plant at the same time allow proper ventilation and spread the roots and growth conditions of natural growth and reduce soil preparation operations and plants be good in response to this type of irrigation systems, which reduces the spread of weeds seeds (Brandt et. al., 1971).

According to the importance of using multiple energy sources in desert region to operate drip irrigation system pumping unit, this study was done.

Material and Methods

The experiment was conducted in the Desert Guide Way Farm which belongs to the Agricultural Extension Department / Agricultural Office in Karbala Government to investigate operating drip irrigation system pumping unit by using multi-power sources.

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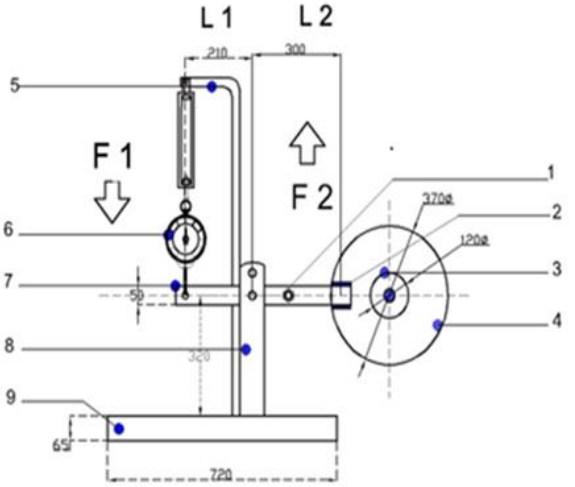
Multi- power Sources with three levels including: pump with motor operated with charged battery by solar and wind power, pump with motor operated with internal combustion engine by bio fuel , pump with motor operated with internal combustion engine by natural fuel (gasoline) which represented main plot and discharge levels including 3.5 m^3. h^{-1} and 1.8 $m^3.h^{-1}$ which represented sub plot were used in this research. Water horse power, break horse power, pumping efficiency, operating cost, were measured in this experiment. Split plot arrangement under randomized complete block design (RCBD) with three replications was used in this experiment.

Pumping unite consist of

1) Power sources including: pump with motor operated with charged battery by solar and wind power, pump with motor operated with internal combustion engine by bio fuel , pump with motor operated with internal combustion engine by natural fuel (gasoline)
2) Centrifugal pump (1 x 1)
3) Design and collect Multi pumping unite belong to dripping Irrigation system.

a) Base metals: connect parts of unit together (engine pump) it was design and manufactured in oriel work houses in Karbala with in studied dimensions.
b) Belt transmission: (V) Belt was used because of it height effacing in transmission movement and other advantage in considering to be a safe ring between pump an engine with ability to Brockport movement for distance .
c) Inverter device: electrical device transformers Direct current to Aerating current , which means invert (D.C) to (A.C) through simple and complicated operation .
d) Pressure gage :- measures positive pressure inside the pipe with range (5– 0 bar) and negative pressure measure measures aren't pressure through in let pipe with range (1 – 0 bar) .
e) Brake Horse Power Dives: Device was manufactured to measure brake horse power (hp) operating by internal combustion engine, (figure,1).



1-adjustment ، 2 – brake ، 3 – pulley for pump 1950 rpm 4 – brake disk ، 5 – arm observation ، 6 –weight scale (Kg) 7 – horizontal arm ، 8 – vertical arm، 9 – base.(All dimensions in mm)

Figure 1. break horse power measuring device.

Studied Properties

1- Water Horse Power (WHP) (hp) :

WHP was measured by the equation proposed by (Altief and Alhadithi , 1988).

WHP = QH / 273

Whereas:

WHP = water horse power
H = vertical pumping height, m
Q = discharge $m^3.h^{-1}$

2- Brake Horse Power (BHP) (hp) :-

Brake horse power was measured according to power sources as fallow:

A- Pump with motor operated with charged battery by solar and wind power: Brake horse power for electrical engine was measured by measuring electrical power according to the following equations which proposed by (Al-Qasiy, 2008)

$$P_{input} = vx\bar{I}xcos\theta$$

Whereas:

P_{input} = consumed power from electrical engine (watt)
$v = volt\ (220\ v)$
Cos θ = power coefficient (0.8) (according to manfuacted company)

Then BHP calculated from the equation which suggested by (Ismail, 2001)

BHP = $P_{out\ put\ x\ drive\ eff}$ .....

Whereas:

BHP = power input to pump (watt)
Drive eff. = transmission (motor) efficiency (0.90 – 0.95)

To transform unite to horse we used equation suggested by (AL-Qasyi, 2008)

$\frac{watt}{1000}$ = kwx1.341 = hp

B- Measuring brake horse power for internal combustion engine:

Brake horse power for internal combustion engine was measured by using the following equation which suggested by (Bhattcharge, 1975)

BHP = (Q*H) / E273

Whereas:

BHP = brake horse power, horse.
Q = distance $m^3.h^{-1}$
H = High vertical pumping .m
E = pump efficiency

3- Pumping efficiency %:

Pumping efficiency is the ratio between water horse power and brake horse power and it was measured by using the equation which suggested by (Arora, 2005)

$$E = \frac{WHP}{BHP}$$

Whereas:

E = full efficeniy for pump %
BHP = brke horse power .hp
WHP = Water horse power .hp

4- Operating Cost, $ / day

The total costs of operating pump with motor working with charged battery by solar and wind energy and pump with motor was operated with internal combustion engine with bio fuel and pump with motor was operated by internal combustion engine with natural fuel (gasoline) were calculated by methods which suggested by Ismail, 2001 and Altahan at. el., 1991.

Results and Discussion:

1- Water Horse Power (WHP) (hp) :

Table (1) showed the effect of power sources and discharge on water horse power. The result showed that there is a difference in water horse power attributed to power sources but it is not significant.

Table (1) showed significant differences in water horse power attributed by discharge. 3.5 $m^3.h^{-1}$ discharge got highest water horse power reached 0.2031 hp while 1.8 $m^3.h^{-1}$ discharge got lowest water horse power, reached 0.1041 hp the reason for that may be because of the increase in vertical pumping height, this result is similar to the result which got by (jasim and AL-Obaidi 2013)

Table (1) also showed the effect of the interaction between power sources and discharge on water horse power. The interaction between pump with motor was operated with charged battery by solar and wind power and 3.5 $m^3.h^{-1}$ discharge got highest water horse power reached 0.203 hp and the interaction between pump with motor was operated with internal consumption engine and 1.8 $m^3.h^{-1}$ discharge got the lowest average of water horse power stood 0.102 hp.

Table 1. The effect of energy sources and pump discharge on water horsepower (hp).

Type of Energy Sources	Interaction Between Energy Sources and Discharges		Average Energy Sources
	3.5 $m^3.h^{-1}$	1.8 $m^3.h^{-1}$	
Pump Operates with Charged Battery by Solar and Wind,	0.203	0.104	**0.153**
Pump Operates by Internal Combustion Engine with Bio Fuel	0.204	0.105	**0.154**
Pump Operates by Internal Combustion Engine with Natural Fuel	0.203	0.102	**0.154**
L.SD= 0.05	**0.0014**		N.S
Average Discharges	0.203	0.104	
0.05L.S.D=	**0.0007**		

2) Brake Horse Power (BHP) (hp) :

Table (**2**) showed the effect of power sources and discharge on water horse power. The result showed that there is a difference in brake horse power attributed to power sources. Pump with motor which operated with internal consumption by bio fuel engine got the highest of brake horse power stood 0.2387 hp while pump with motor was operated with charged battery by solar and wind power got the lowest brake horse power stood 0.2343 hp

Table (**2**) showed significant differences in brake horse power attributed by discharge. 3.5 $m^3.h^{-1}$ discharge got highest brake horse power reached 0.2891 hp while 1.8 $m^3.h^{-1}$ discharge got lowest water horse power, reached 0.1837 hp the reason for that may be because of the increase in discharge require increase in velocity and then increase brake horse power , this result is similar to the result which got by Bachus,2003.

Table (**2**) also showed the effect of the interaction between power sources and discharge on brake horse power. The interaction between Pump with motor which operated with internal consumption by bio fuel engine and 3.5 $m^3.h^{-1}$ discharge got highest brake horse power reached 0.2900 hp while the interaction between pump with motor was operated with charged battery by solar and wind power and 1.8 $m^3.h^{-1}$ discharge got the lowest average of brake horse power stood 0.1820 hp.

Table 2. The effect of energy sources and pump discharge on brake horse power, hp.

Adjective Studied	Interaction Between Energy Sources and Discharges		Average Energy Sources
	3.5 $m^3.h^{-1}$	1.8 $m^3.h^{-1}$	
Pump Operates with Charged Battery by Solar and Wind	0.2867	0.1820	0.2343
Pump Operates by Internal Combustion Engine with Bio Fuel	0.2903	0.1870	0.2387
Pump Operates by Internal Combustion Engine with Natural Fuel	0.2900	0.1843	0.2372
L.SD= 0.05	0.0063		0.0044
Average Discharges	0.2891	0.1837	
0.05=L.S.D	0.0089		

3. Pump Efficiency

Table (3) showed the effect of power sources and discharge on water horse power. The result showed that there is a difference in pump efficiency attributed to power sources but it is not significant.

Table (3) showed significant differences in pump efficiency attributed by discharge. 3.5 $m^3.h^{-1}$ discharge got highest pump efficiency reached 70% while 1.8 $m^3.h^{-1}$ discharge got lowest pump efficiency, reached 56.73 the reason for that may be because of the increase in water horse power and save energy with no lost.

Table (3) also showed the effect of the interaction between power sources and discharge on pump efficiency. The interaction between pump with motor was operated with charged battery by solar and wind power and 3.5 $m^3.h^{-1}$ discharge got highest pump efficiency reached 70.72% while the interaction between pump with motor was operated with internal consumption engine by bio fuel and 1.8 $m^3.h^{-1}$ discharge got the lowest average of pump efficiency stood 56.11%.

Table 3. The effect of energy sources and pump discharge on pump efficiency,%.

Adjective Studied	Interaction Between Energy Sources and Discharges		Average Energy Sources
	3.5 $m^3.h^{-1}$	1.8 $m^3.h^{-1}$	
Pump Operates with Charged Battery by Solar and Wind	70.72	57.11	63.91
Pump Operates by Internal Combustion Engine with Bio Fuel	70.21	56.11	63.16
Pump Operates by Internal Combustion Engine with Natural Fuel	70.14	56.55	63.35
L.SD 0.05	2.426		N.S
Average Discharges	70.28	56.73	
0.05L.S.D	1.213		

4. Pumping Operating Costs, $/day

Table (4) showed the effect of power sources and discharge on operating costs. The result showed that there is a difference in operating costs attributed to power sources. Pump with motor which operated with internal consumption engine by natural fuel got the highest of operating costs stood 4.50 $/day while pump with motor was operated with charged battery by solar and wind power got the lowest operating costs stood 0.71 $/day.

Table (4) showed significant differences in operating costs attributed by discharge. 3.5 $m^3.h^{-1}$ discharge got highest operating costs reached 2.74 $/day while 1.8 $m^3.h^{-1}$ discharge got lowest water horse power, reached 2.49 $/day the reason for that may be because of the increase in pumping draft which require spend more fuel , this result is similar to the result which got by Alobaidi,2011.

Table (4) also showed the effect of the interaction between power sources and discharge on operating costs. The interaction between pump with motor was operated with charged battery by solar and wind power and 3.5 $m^3.h^{-1}$ discharge got the lowest operating costs reached 0.71 $/day while the interaction between Pump with motor which operated with internal consumption engine with natural fuel and 3.5 $m^3.h^{-1}$ discharge got the highest average of operating costs stood 4.62 $/day.

Table 4. The effect of energy sources and pump discharge on operating Cost ($ / day).

Adjective studied	Interaction between energy sources and discharges		Average energy sources
	3.5 $m^3.h^{-1}$	1.8 $m^3.h^{-1}$	
Pump Operates with Charged Battery by Solar and Wind	0.71	0.71	0.71
Pump Operates by Internal Combustion Engine with Bio Fuel	2.89	2.39	2.64
Pump Operates by Internal Combustion Engine with Natural Fuel	4.62	4.39	4.50
L.SD 0.05	0.023		0.016
Average Discharges	2.74	2.49	
0.05L.S.D	0.013		

Conclusions

1- Pump with motor was operated with charged battery by solar and wind power was dominated on all characters except brake horse power.

2- More researches on using multi power resources to operate drip irrigation Pump in desert region are recommended.

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