Electrical charge and discharge characteristics of battery under remote control of water level with PV pumping system

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Abstract. This paper presents introduction and load characteristics of stand-alone PV pumping system, which was especially designed for rice planting irrigation of small form units, under remote control of water level. By application of these systems, it is expected to increase agricultural fresh water reuse, and to save labor for water management. The feature of this system is simplicity with having the control function of matching to weather condition. We confirmed remote control of water level by using batteries under cloudy.

Keywords
PV pumping system, rice irrigation, weather control mode, water level, remote control

1. Introduction

The purpose of this study is to research the practical use of PV pumping system for rice planting irrigations that conforms small farming units. The application model of PV pumping system is shown in Fig.1. Rice plantings in paddy field require a lot of fresh water. The water management of rice planting in Japan is mainly to keep water depth, changing its level as rice plants grow. Main factors of water level control are irrigation input, drainage output, rainfall, evaporation, transpiration, percolation and leakage. We have examined remote control of water level for rice plantings by using PV pumping system.

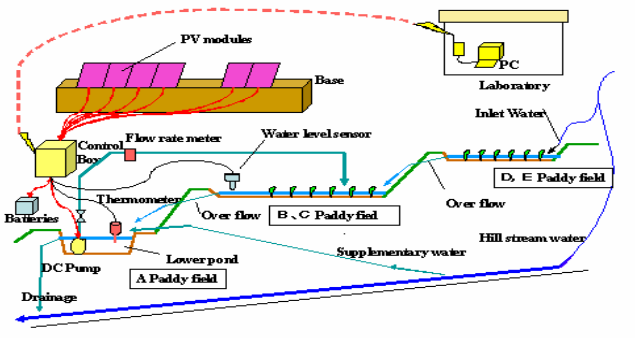

Fig.1 Remote control system of water level in paddy field

2. Experimental Apparatus

A. PV pumping system

We made an experimental system making use of the characteristic between solar modules' current and irradiation to control water level remotely by using valves and PV pumping system. The experimental system is a type of stand alone with batteries, DC 24V pump and control-panel with charge/load controllers. Main specification is shown in Table.1 and its outward appearance is shown in Fig.2.

Fig.2 Experimental system

Table.1 Main specifications

Items	Q'ty	Specifications
1.System	-	Stand-alone type, DC24V system
2.Solar modules	4	128W,1200mm×800mm
3.Controllers	2	Charge and Load Controller
4.Batteries	2	DC12V enclosed cell
5.Pump	1	DC24V 8.5A 4m^3/h×1.3m

This control method is the following. From the value of solar modules' current loaded DC-pump, it checks indirectly weather condition at that time. This idea is to use approximate proportional relation between solar modules' current and irradiation when the load and the system voltage are about constant, and within the

modules' current ranges under dc-pump rated ampere. At that time batteries supply the shortage of current for load.

B . Remote control system of water level

Figure 1 shows remote control system of water level in paddy field. We will be able to control water level of paddy field by using personal computer and mobile telephones as we stay in our laboratory. Warm water will be beforehand supplied from lower pond to upper paddy field according to forecast of the cold day. The rice plant is protected by deep waters.It is expected to save labor for water management.

C . Energy Management System

Figure 3 shows energy management system. The lower tank mocks an irrigation pond, which saves warm water. The upper tank mocks paddy field. In preparation for cold day, deep water level is established for upper tank, which mocks paddy field, from the weather forecast.
We used two controllers. One of them is the load controller and another one is the solar charge controller. The switchover between charge control mode of the batteries and DC load control was easily done by establishment of pin . When voltage was over the value established, the load was cut off automatically and damage of battery due to over discharge was prevented.

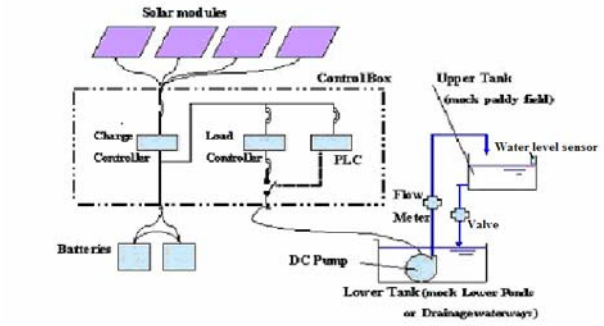

Fig.3 Energy management system

3. Results and Discussion

Figure4 shows the example of dynamic characteristics of current and solar irradiation when the pump was driven under fine day. Figure 5 shows dynamic characteristics of current and solar irradiation under cloudy. Discharge current flows from condenser to pump. Energy flow under cloudy is shown in Fig.6. Solar modules generate output power 138.3(W). The input power 69.2(W) from controller and discharge power 26.9(W) from battery are supplied to the pump. It appears that the remainder power was consumed in the control panel.

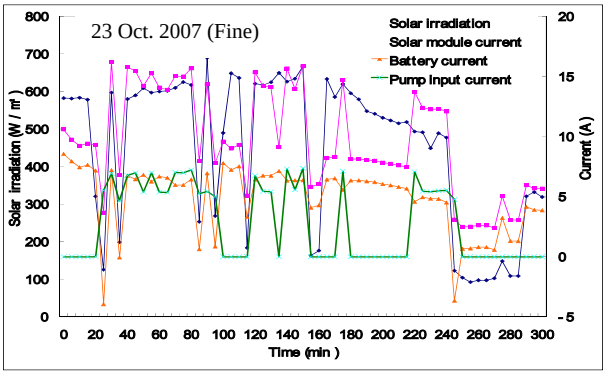

Fig.4 Characteristics of current and solar irradiation under fine

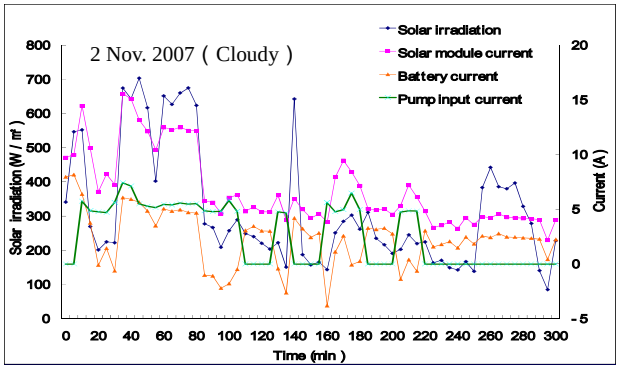

Fig.5 Characteristics of current and solar irradiation under cloudy

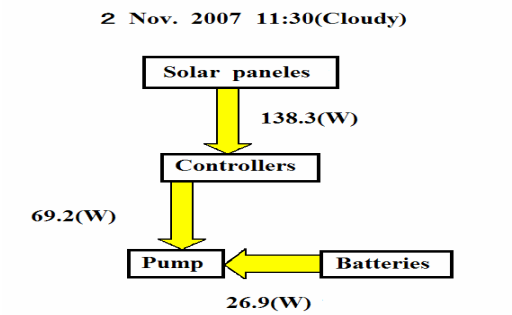

Fig.6 Energy flow(cloudy)

4. Conclusion

We checked enough validity that the batteries were able to cover energy by discharge for remote control of water level under cloudy.

REFERENCES

[1]Kiyomi Niiyama, Masaki Sato and Hiroyuki Toyokawa, "Stand-alone PV pumping system applied the approximate linear relation between irradiance and PV modules ' current ",2005 ANNUAL MEETING RECORD I.E.E. JAPAN, (2005) p.24