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Energy Optimization by Parameter Matching for a Truck-Mounted Concrete Pump

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Abstract

Aiming at the shortages of low efficiency and large fuel consume of a truck-mounted concrete pump, a global power matching method are proposed based on both fuel consume rate of the engine and efficiency of the hydraulic pump. The combination optimization on fuel consume rate of the engine and efficiency of the hydraulic pump are realized by genetic algorithm. The control objects, as far as the rotating velocity of the engine and the displacement of the hydraulic pump, can be adjusted at the same time and follow with the load adaptively, resulting in that all the components working at high efficiency region. The comparative experiments are tested with the new and old methods. The results showed that the new one was superior to the old. The average energy save ratio is 16%.

Peer-review under responsibility of the organizing committee of CUE 2015

Key wors: fluid power and control, power matching, energy economy, efficiency

Nomenclature

Q	the pump flow
P	the pump pressure
n	the pump velocity
q	the pump displacement

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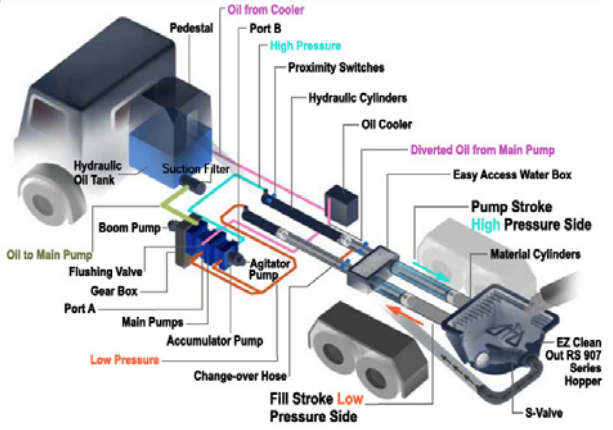
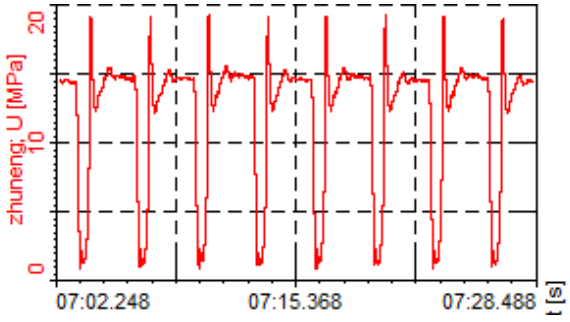
1. Introduction

With ever increasing concerns on the energy diversification and environmental protection, the energy conservation technology has been widely used in automobile industry, such as a hybrid electric vehicle[1]. As we know, the power of a truck-mounted concrete pump is at least twice more than that an automobile, for instance the engine power of a truck-mounted concrete pump is 214kW and that the power of a Toyota Prius is only 73kW[2]. So the energy conservation technology is much more important than an automobile. The hydraulic system of a concrete pump is a typical open-loop system, as shown in figure 1(a). Because that the fuel consume of a truck-mounted concrete pump are variable with different load(figure 1(b)), the optimal control for the engine output power can realize the objective of energy conservation.

The hydraulic system consists of the engine, the main pump and the hydraulic cylinders. Field test found the hydraulic shock of the main pumping outlet is serious, and heard great sound of the piston striking the bottom of the cylinder. When the pumping load varies in the range of 0MPa to 20MPa, the piston stroke decreases with the increase of the variation of the pumping load, and leads to the pumping insufficiency. Therefore, the mismatch between varying loads and system's open-loop control property can leads to the problem of pumping insufficiency[3]. Therefore, in order to solve foresaid problem, the optimal model of concrete pumping displacement control must be built to find the best set of control parameters which is suitable for a wide range of dynamic load.



(a) The Schematic diagram



(b) The load vibration characteristics

Figure 1 The outline of a truck-mounted concrete pump