

Water Pump

June 12, 2011

Abstract

The water pump team is investigating manual water pumping systems that can be used by the AguaClara plant operator to lift water two to three meters from the settled water channel (or the filter outlet box) to the chemical stock tanks. Preliminary research suggests that foot or hand operated piston and diaphragm pumps are the most promising. In making this decision, construct-ability, simplicity of repair, access to materials in resource-poor communities, and possible failure modes are considered. At this point we have calculated both the discharge rate head loss of several pump designs using Mathcad. With the current design specifications we have come to the conclusion that a diaphragm pump is the most ideal pumping system available for the specified job.

students 3 PT

skills fabrication, some fluid mechanics

1 Introduction

The goal of this team is to design, fabricate, and test a pump that can deliver about 1 L/s using human power. The pump fabricated during the spring semester can serve as a prototype. Preliminary investigation during the spring of 2011 revealed that piston pumps are challenging to build because of the requirement of a sliding seal between the piston and the cylinder. A diaphragm pump that uses a flexible membrane doesn't have any sliding seals and is thus easier to build. The challenge is to see if we can design and fabricate a diaphragm pump that is reliable, efficient, and easy to construct.

1. Find a more ideal membrane material. The flat sheets of santoprene don't work well because of the poor geometry. We need a method to fabricate cylindrical membranes. One possibility is to use a toilet plunger. They have a reasonable shaped flexible membrane. The material needs to be able to meet the following qualifications:
 - (a) The material needs to be robust enough to withstand constant use without fracturing or leaking.

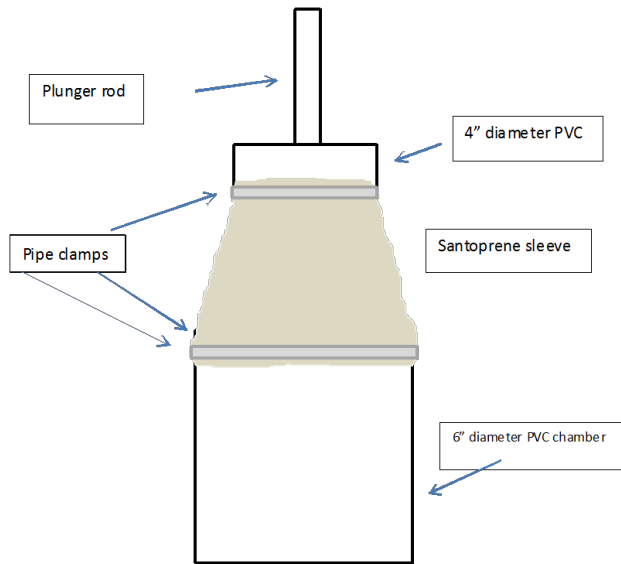


Figure 1: Diagram of plunger-based diaphragm pump

- (b) The material needs to be able to withstand several meters of head without deforming or ripping.
 - (c) The material should be cylindrically shaped such that there can be a decent stroke length without there being any wrinkling of the membrane when attaching the membrane to the outside of the pump casing.
2. There are several options for driving the plunger attached to the membrane. The membrane system can be fit to a
 - (a) treadle pump where the operator stands on two levers that are connected to two plungers
 - (b) direct acting diaphragm pump where the operator pushes and pulls the plunger rod
 - (c) lever diaphragm pump where the operator moves a lever by hand that is connected to the plunger
3. Look at the AguaClara plant layout and come to a conclusion on the pump's positioning and how it will be implemented in the plant overall.