Estimating Irrigation Pumping Plant Efficiency

Danny H. Rogers
Extension Agricultural Engineer
K-State Research and Extension
Dept. of Bio and Ag Engineering
Kansas State University
Manhattan, Ks 66505
Voice: 785-532-5813 Fax: 785-532-6944
Email: drogers@bae.ksu.edu

Introduction

Irrigated agriculture in Kansas uses groundwater as the primary water source. Much of the access to this water requires the use of deep wells but even in the more shallow alluvial aquifer systems, energy costs for pumping can be significant. Of course, an increase in energy cost, increase in pumping lift or increase in the total volume pumped causes a direct increase in pumping cost. Pumping costs also increase when changes in pumping conditions and regular wear and tear on pumping plant components result in a loss of pumping plant pumping efficiency.

Pumping Plant Efficiency

Any of the major components of a pumping plant, i.e. the pump, the gear head or drive, or the engine or motor, can be the cause of poor performance. Limited surveys of pumping plants in Kansas indicate the average unit uses about 40 percent more fuel then necessary for the given pumping conditions. In addition, many wells, due to age, initial construction techniques, screen incrustation, and declining water levels, have reduced specific yields. Some of this loss of capacity may be possible to recover with proper well maintenance. High well efficiency should be a concern whenever a replacement well is being considered, as new design and well construction techniques can help obtain good yield with the minimum drawdown during pumping.

Causes of poor pumping plant efficiency

Causes of poor pumping plant efficiency and subsequent excess fuel use include:

1. Poor pump selection.
Pumps are designed to best operate for a particular combination of head and discharge for a given operating speed. If the operating conditions were either not properly matched to a given pump or the conditions changed from the initial conditions, the pump efficiency will be poor.

2. Pumps out of adjustment.
Pumps need to be set to have proper operational clearance. Improper initial adjustment or improper clearance that develops over time due to wear will result in loss of pump efficiency.

3. Worn or broken pumps.
A pump is like any other piece of machinery. It has a useable life span determined by time, use, and operating conditions.

4. Improperly sized engines or motors.
Power plants, especially engines, must be properly selected to operate with the proper loading and operating speed combination to provide good fuel use efficiency.

5. Power plants in need of maintenance or repair.

6. Improperly matched gear heads.
Gear heads (and belt drives) must be properly selected to match the pump and engine speeds and be in good repair.

7. Changes in well performance.
Declining water tables and incrustation build up on well screens effect the yield ability of the well and cause other performance problems , such as cascading water and surging. These conditions may require alteration of the pumping discharge rate.

Estimating pumping plant efficiency

A pumping plant efficiency evaluation can be obtained by hiring a consulting firm of well driller that have the equipment and experience to make the necessary measurements and calculations. As an option, an estimate of the pumping plant efficiency can be made using pumping plant information and on-farm fuel bills. This information can be compared to Nebraska pumping plant performance criteria (NPC). The NPC is a guideline on fuel use requirements for a well designed and properly maintained pumping plant. The estimation of pumping plant efficiency will only be as good as the information used in the estimate.

The comparison can be accomplished by using the K-State Research and Extension Bulletin, L-885, " Evaluating Pumping Plant Efficiency" or using a new computer decision-support software program, called FuelCost. Either method will help determine whether the pumping plant is using more fuel than necessary for the pumping conditions. FuelCost also allows the operator to do some additional fuel related comparisons, such as energy source cost comparison.

Regardless of whether the pumping plant analysis is done using the bulletin or FuelCost, the following information is needed:

1. Acres irrigated,
2. Discharge rate,
3. Total Dynamic Head - estimated using system pressure and pumping lift,
4. Total application amount,
5. Total fuel bill, and
6. Fuel price per unit.

FuelCost can be downloaded from the Mobile Irrigation Lab website at www.oznet.ksu.edu/mil. Other on-line tools are also available at the site. For individuals without web access, check with your local county agent for the bulletin or MIL programs on CD's.

Summary

Irrigation energy costs can be a significant portion of the production costs associated with irrigated agriculture. FuelCost or Extension bulletin L-885 are tools to help irrigators make certain the costs are appropriate for the amount of water pumped for the given field conditions.

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