Dynamometer Lease Studies

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ABSTRACT

A reduction in maintenance and operating costs on pumping well leases can be just as beneficial as an increase in production. Tremendous savings are possible on many leases if a practical dynamometer survey is initiated. The dynamometer and related test data can offer the basic requirements for lease cost analysis.

This paper will discuss numerous ways that a dynamometer can be applied to lease studies and will present examples of the resulting improvements.

INTRODUCTION

A lease dynamometer study should be well planned, with each well being studied carefully prior to initiating the survey. The personnel involved with the lease operations should be consulted and their ideas, suggestions, and observations recorded. These men must be kept informed as to the purpose and progress of the lease study, for their cooperation and understanding are essential to successful project completion.

The primary purpose of this paper will be to show how the dynamometer can be coordinated with and applied to multiple well studies. Individual well weighing is usually the result of a particular well problem. In lease studies the readily apparent problem is not the only consideration; many wells produce top allowable or capacity, trouble free, but the operation might still be improved if this same work could be done at a reduced cost.

Many times seemingly small deficiencies on individual pumping wells do not appear costly or important enough to warrant immediate correction. When these semmingly minor costs are accumulated and studied on a lease or field basis the total annual cost can be staggering. More than enough expense often will be involved to justify corrective action or informative test work on one or more wells.

When a lease or field study program is first initiated, test priority will generally be assigned to the following types of leases:

1. Leases having water flood production.
2. Leases with frequent equipment failures.
3. Leases using electric power.
4. Leases where apparent pump efficiency is less than 60 percent.
5. Leases with wells producing less than top allowable.
6. Leases having special problems.

Many leases will qualify under all six catagories and the immediate desirability for a dynamometer study cannot be overemphasized.

LEASES HAVING WATER FLOOD PRODUCTION

Water flood production practices differ from normal operations in that each well should be equipped to obtain a steady fluid production increase as the flood progresses. Even during the later life when a decline in oil production is experienced, the equipment often must handle a maximum volume of fluid to obtain the necessary volume of oil. The supervisor of a water flood lease should know that the following conditions exist:

1. The maximum well capacity is being produced from each well.
   The dynamometer fluid pound test will furnish this information.
2. The equipment is capable of handling, and is not being overloaded by, the well load.
   Actual well loads can be obtained from the dynamometer card.
3. The pump capacity is sufficient to produce the required fluid volume.
   Dynamometer card analysis will offer complete data for pump analysis.
4. The pumping time and equipment size are controlled so that the operating cost and equipment wear are maintained at a minimum.
   The dynamometer fluid pound data permits scheduling of minimum pumping time.

Since the production increase is an important phase of flood operation, any time a well continues to produce the same fluid volume each day it should be tested to insure sufficient pump capacity is available to maintain a fluid pound condition.

The unit prime mover, rods and pump capacity should be observed and compared with well loads. This study permits equipment size changes to be anticipated so that down time and equipment failures can be maintained at a minimum. The following examples show typical results found by pumping well tests on a water flood lease.

	Prod. Bbls.			Pump Capacity	
	Oil	Wtr.	Hrs.	Bbls.	Remarks
Well "A"	13	36	24	123	Small traveling valveleak. Pump continues to pound fluid. Shorten stroke and reschedule.

	Prod. Bbls.			Pump Capacity	
	Oil	Wtr.	Hrs.	Bbls.	Remarks
Well "B"	5	199	24	190	No fluid pound Speed up unit, run larger pump.

After recommended changes:

	Prod. Bbls.			Pump Capacity	
	Oil	Wtr.	Hrs.	Bbls.	Remarks
Well "B"	25	225	24	270	Valves good, pump pounds fluid.

EXAMPLE 1

LEASES WITH FREQUENT EQUIPMENT FAILURES

Failures in surface pumping facilities are generally caused by improper equipment, improper maintenance, and unusual operating conditions such as bad fuel, excessive range of load, and electric power problems. The dynamometer can be used to check well loads to determine if the trouble source originates down-hole. This information, used with auxiliary instrument data and past equipment failure studies, will assist in pointing out the problem cause and in determining the necessary preventative action.

Many times when well loads cause the surface equipment failures, a change in operational design or mechanical design can rectify the problem with little expense. Small changes in stroke length, speed, and pumping time can vary loads considerably. A change in pump size, removal of packers or relief of unusual down-hole problems often will remove the source of trouble with little added expense.

The dynamometer is invaluable in furnishing information to assist in evaluating down-hole problems. The most frequent causes of subsurface equipment failures appear to be corrosion, excessive range of load, improper equipment, improper operating design, and the handling of gas and foreign material through the pump. The dynamometer test can furnish the necessary data to indicate the severity of these problems. The inspection of the actual point of failure, the well fluids and the well characteristics will often determine the cause and probable remedy.

The effects and benefits attained from a lease study of subsurface equipment failures are shown by the pulling frequency curve in Fig. 1. Equipment problems were caused by both overloading and corrosion.

LEASES USING ELECTRIC POWER

In most instances a reduction of electrical power costs will be the first benefit attained from dynamometer studies on electrified leases. This is true because pumping time schedules can be quickly determined and properly arranged. Additional reductions in cost will result from reduced well loads, unit speeds and overall efficiency losses. The control of electrical costs is a good example of the benefits that can be obtained from lease studies.

Although the individual well analysis is the basis for such a study, the overall operation must be reviewed if maximum improvements are to be obtained. Inspection and maintenance of the electrical distribution system, meters, controls and motors is also an important phase of lease study. Improper counterbalancing will contribute to extra motor loadings. Counterbalancing should be checked and corrected regularly if the best efficiency is to be maintained.

An example of the benefit obtained from controlled pumping time and reduced loads in lease studies is shown by the electric cost graph in Fig. 1.

Frequent review of the electric bill and well time schedules is recommended. To facilitate this work the authors suggest making a lease summary table that would include the lease name, number of wells, total horsepower, monthly electric cost, kilowatt demand and kilowatt hours. As these items are recorded each month, a brief comparison with previous monthly figures will indicate the following:

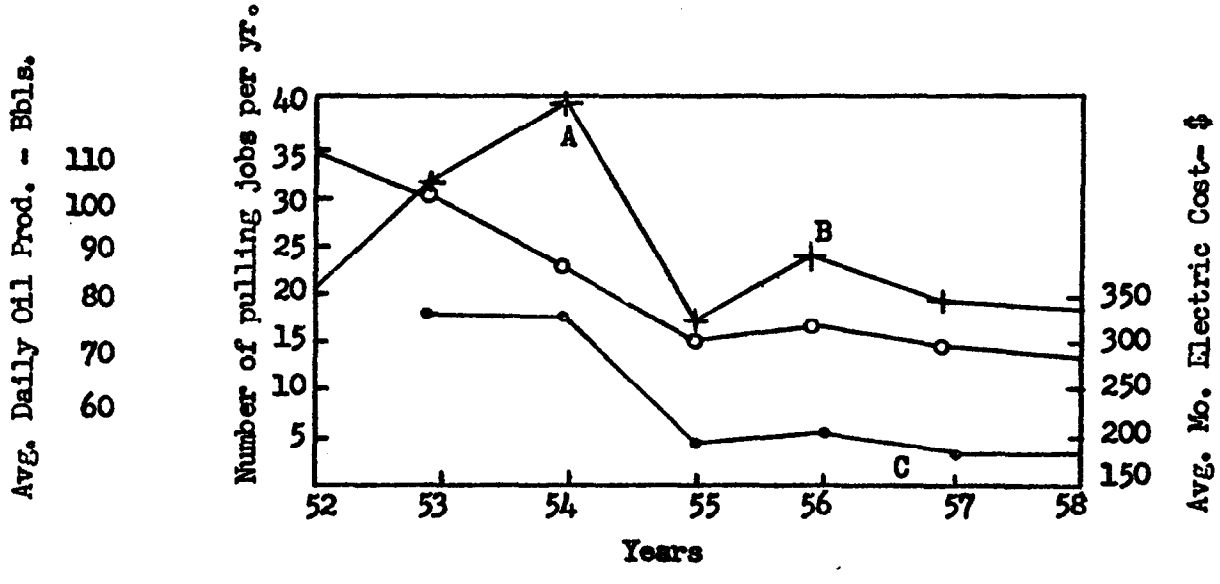
1. Proper well scheduling;
2. Electric load consistancy;
3. Proper pumping periods;
4. Sufficient transformer capacity;
5. Correct billing.

LEASES WHERE APPARENT PUMP EFFICIENCY IS LESS THAN 60 PERCENT

Low pump efficiency can easily be called the "Black Plague" of the oil fields. Close supervision and frequent lease review are the basic requirements to minimize this problem.

The apparent volumetric pump efficiency can be calculated prior to lease work and the principal cause of

FIG. 1



A - Initial Dynamometer Survey
B - Six Jobs Due to Scale in One Well
C - Two Wells Abandoned

+——+ Pulling Jobs
o——o Avg. Daily Oil Prod.
•——• Avg. Mo. Electric Cost

low efficiency can generally be assigned to extended pumping time or down-hole problems. Except in unusual conditions, time scheduling should be corrected immediately.

The major causes of low pump efficiency are: gas, improper design, improperly sized equipment, foreign materials such as sand and scale, equipment wear, or leaks. Here again, the dynamometer card analysis is an essential procedure in determining which problem exists. This is true because a study of the pump in action is the most accurate approach to determine a solution of down-hole problems.

Generally, after the primary lease weighing operation, a comparison of the various well analyses will indicate common problems. From the wells most severely hampered by low efficiency one or more test wells can be chosen and the recommended equipment and operating changes can be made. The test results will present the necessary information to evaluate the economics of a field or lease modification.

The two wells shown in Example 2 were tested on a lease where gas interference prohibited the determination of well capacity.

	Prod.Bbls.	Hrs.	Remarks
Well #1	43	24	Severe gas interference will not pound fluid.
Well #2	38	24	Production capacity unknown. Recommend improvement in mud anchor and gas anchor design.

After improvements were completed:

	Prod.Bbls.	Hrs.	Remarks
Well #1	76	24	Top allowable and well capacity. Well pounds fluid. Producing capacity.
Well #2	38	24	

EXAMPLE 2

Although a production increase was gained by only one well, both tests can be considered successful. The improved conditions in Well No. 2 permit accurate testing, the measuring of well capacity, and the regulating of proper pumping time.

The full series of tests will furnish the required information needed to design the most efficient down-hole equipment.

Other well problems can be evaluated by dynamometer and related test work and basic improvements can be applied in a similar manner.

Numerous lease studies have shown that the pump efficiency can be raised above 60 percent on every lease where operations permit time scheduling. The overall pump efficiency on the lease summarized in Fig. 1 was increased from 17 percent to 66 percent.

LEASES WITH WELLS PRODUCING LESS THAN TOP ALLOWABLE

Leases with wells producing less than top oil allowable must be closely supervised if operating costs are to remain reasonable. All of the problems previously mentioned frequently occur on this type lease and small increases in operating costs may effect a large decrease in profits. Fig. 1 represents studies on a stripper lease. The reduction in annual electric costs alone, $1700 per year, indicates the benefits of lease dynamometer studies.

LEASES HAVING SPECIAL PROBLEMS

Many special lease problems such as paraffin, excessive lost production time, periods of concentrated maximum production rates, and improperly sized treating and storage facilities can be reviewed along with well studies. Quite often adjustments in materials and procedures will reduce the extra operating costs caused by these problems.

SUMMARY

Dynamometer lease surveys often will result in reduced operating costs and improved operations. To be successful, a lease study must be well planned and executed. To sustain the benefits obtained, regularly scheduled operational reviews should be conducted.

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