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SECONDARY RECOVERY CAN SALVAGE STRIPPER WELL RESERVES IN ILLINOIS

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SECONDARY RECOVERY CAN SALVAGE STRIPPER WELL RESERVES IN ILLINOIS

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THE record of the old fields of Illinois for the past 37 years indicates that a substantial part of the total production came from wells whose daily production was so low that they yielded only a small margin of profit. Such wells are now known as "stripper" wells. The normal history of an Illinois oil well is that it is a "flush" producer for a relatively short time, a few months or a very few years at the most. Then for the rest of its life, which may be several decades, it is in the "stripper" class.

It is difficult to define a stripper well precisely. Even if an acceptable definition in terms of rate of return be adopted, the application of this definition to Illinois fields which comprise some 24,000 producing wells would be a large task. For the purpose of this paper a stripper well is arbitrarily defined as one producing less than 10 bbl. per day.

If this definition of a stripper well is accepted, then essentially all the wells in the old Illinois fields fall into this class along with almost a third of those in the new fields discovered since 1936. Furthermore, decline curves for the new pools indicate that the remaining two-thirds will probably be in the stripper class within 3 years. In other words, it is probable that all the wells now drilled in Illinois will be strippers before the end of the war.

As there is no guarantee of new production from wildcat wells, the old production is all that we can count on at a time when an assured supply is vital. The stripper wells in Illinois are favorably located with reference to transportation facilities and refineries, as shown by a glance at the State Highway map and the Illinois oil and gas map which also shows pipe lines, waterways, and railroads.

Stripper wells produce from all the Illinois oil-producing formations, which range in depth from a few hundred to 4,500 ft., with an approximate average depth of 1,000 ft. for the old fields and 2,500 ft. for the new. For specific information as to the depth of producing formations and pools the reader is directed to the state Geological Survey's monthly oil and gas drilling report.

If, during the war, it is essential that refineries operate at full capacity, it is essential that adequate supplies of crude oil are available at all times. Since the oil transportation facilities of the nation — pipe lines, tank cars, and tankers — are overtaxed in an effort to supply the war needs on the Atlantic seaboard and in the Pacific Northwest, not to mention other critical areas, it is essential that resources near refineries be fully utilized. The stripper well must, in this case, be considered as a backlog of assured production during the intervals between new discoveries with flush production. A policy of their continuation must not be based altogether upon the prices determined by larger production, or strictly on a basis of allocation of steel or other necessary producing equipment.

The continuance of a stripper well in the immediate locality of a refinery may mean just that much oil added to the supply when a large producer far from a refinery becomes less effective in maintaining a flow of crude to the refinery, simply be-

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This paper is revised and expanded from a statement on "Stripper Well Production in Illinois" furnished to the research and coordinating committee of the Interstate Oil Compact Commission for its meeting in Oklahoma City, Dec. 18 and 19, 1942.

RESULTS ON OIL PRODUCTION OF ACCIDENTAL FLOODS IN ILLINOIS

Name of lease, location, and group	Time of flood	No. of years production used	Bbl. of flood increase	No. of wells flooded	Flood production per well	Av. flood production per yr. per well	No. of acres flooded	Flood production per ac.	Av. flood production per yr. per ac.
Kraft, 1-7n-13w, Kibbe*	1923-31	9	38,500	4	9,625	1,069	7	5,500	611
McKnight, 12-7n-13w, Kibbe*	1911-	20	22,843	1	22,843	1,142	2.5	9,137	456
Hawkins, 31-7n-13w, Oblong*	1917-18	1	5,250	1	5,250	5,250	2.5	2,100	2,100
Wurtzberger, 28-7n-13w, Oblong*	1926-	6	4,516	1	4,516	752	2.5	1,806	301
Frazier, 30-7n-13w, Oblong*	1929-	3	5,114	2	2,557	852	5	1,023	341
Rhodes, 30-7n-13w, Oblong*	1922-	10	18,272	1	18,272	1,827	2.5	7,308	730
Hook and Wylde, 30-7n-13w, Oblong*	1928-	4	2,854	1	2,854	713	2.5	1,141	285
E. V. David, 31-7n-13w, Oblong*	1925-	4	5,950	2	2,975	743	5	1,190	297
D. P. Kirtland, 5-7n-13w, Oblong*	1925-	7	5,898	1	5,898	842	2.5	2,359	337
Harbinson, 6-7n-13w, Oblong*	1927-	5	7,380	1	7,380	1,476	2.5	2,952	590
D. A. Mefford, 28-7n-12w, Robinson*	1918-	16	18,218	1	18,219	1,138	2.5	7,287	455
C. C. Baker, 21-7n-12w, Hebron*	1920-	16	16,000	2	8,000	500	10	1,600	100
Lawrence and Funk, 21-7n-12w, Hebron*	1915-29	14	12,656	1	12,656	904	2.5	5,062	361
Oliver Lowrentz, 7-5n-13w, Hardinsville*	1924-30	8	25,307	2	12,653	1,606	12	2,109	264
Mary Hoke, 7-5n-13w, Hardinsville*	1924-30	8	13,700	3	4,566	570	7.5	1,826	278
P. Fowler, 26-6n-13w, Hardinsville*	1921-26	5	3,160	1	3,160	632	2.5	1,264	252
Ma Sparks Acct. 2, 36 and 1-6n-13w, Hardinsville*	1932-	4	10,779	1	10,779	2,695	4	2,695	674
Asbury Pope, 36 and 1-6n-13w, Hardinsville*	1912-24	12	35,957	1	35,957	2,996	5	7,191	599
W. Montgomery No. 2, 20-5n-12w, Montgomery*	1925-	7	6,451	1	6,451	921	2.5	2,580	370
H. C. Johnson, 25-5n-13w, Tracey†	1933-	4	1,250	1	1,250	312	2.5	500	125
Oscar Smith, 20-4n-12w, Kirkwood‡	1925-30	7	36,689	1	36,689	5,241	5	7,338	148
T. E. Combs, 20-4n-12w, Kirkwood†	1926-	11	60,606	2	30,303	2,754	5	12,121	1,102
Alice Biehl, 14-1n-12w, Allendale§	1935-36	2	7,630	1	7,630	3,810	2.5	3,052	1,526
Jake Smith, 22-1n-12w, Allendale§	1935-36	2	17,577	3	5,859	2,930	7.5	2,343	1,171
Stillwell, 7-1n-11 and 12w, Allendale§	1935-36	1	3,900	1	3,900	3,900	2.5	1,560	1,560
Joe Keyser, 13-1n-12w, Allendale§	1935-36	2.25	12,594	2	6,297	2,800	5.0	2,519	1,119
Della Wright, 8-1n-12w, Allendale§	1935-36	1.75	13,257	1	13,257	7,600	2.5	5,303	3,030
			412,308	40			115.5		

*Crawford County, Robinson sand. †Lawrence County, Tracey sand. ‡Lawrence County, Kirkwood sand. §Wabash County, Beihl sand.

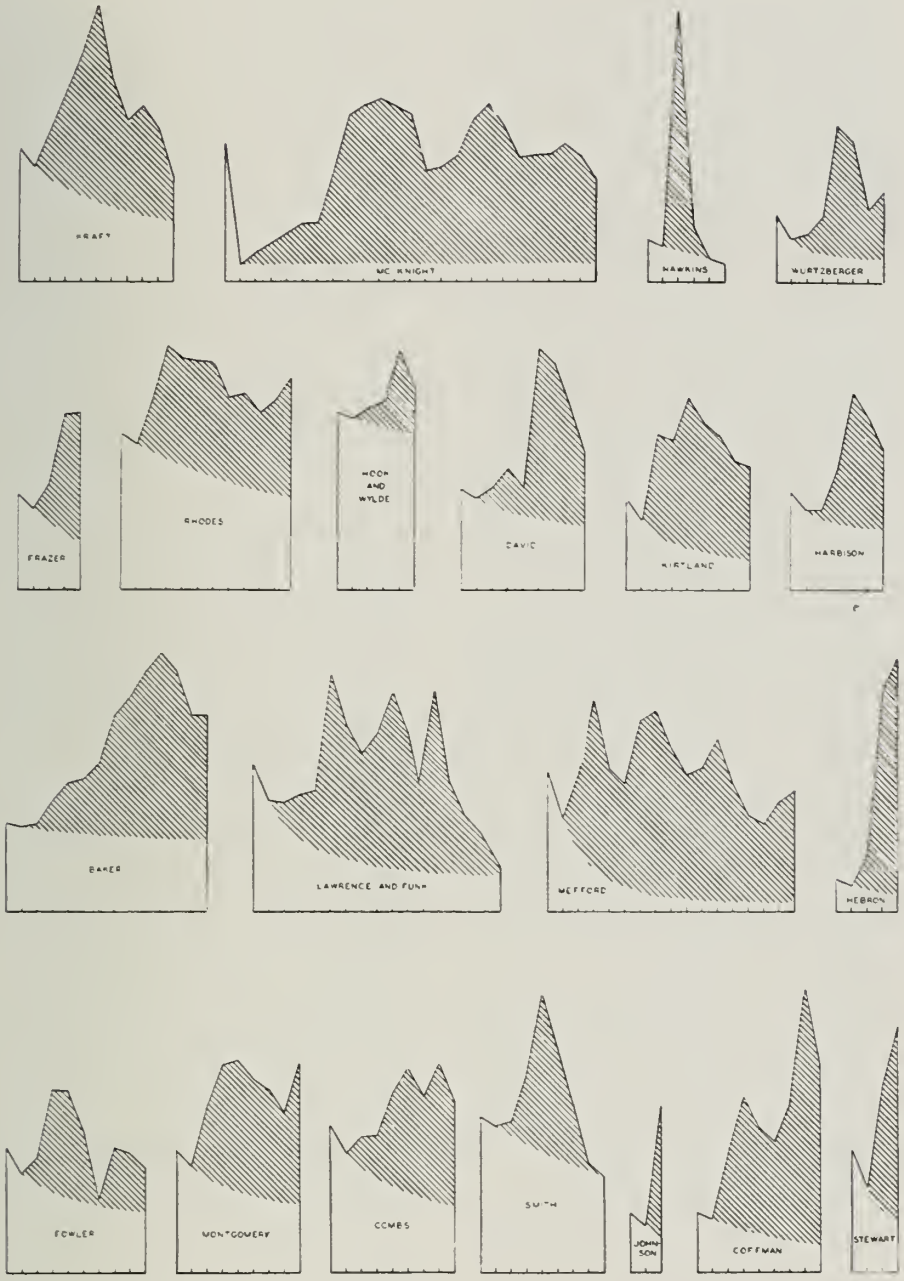

Fig. 1—Production graphs of accidental floods. Time in years, horizontal; annual production, vertical (scales vary). Shaded areas represent production due to flooding

cause of the critical transportation situation.

It is noteworthy that in addition to the butane from natural gas produced in Illinois, a large quantity of butane is also available from the cracking of crude oil at refineries already equipped for this process. Illinois is therefore a natural location for the manufacture of butadiene for synthetic rubber.

Gas Repressuring

Only through secondary recovery can declining production in stripper pools be arrested and changed to increased production. That this can be done is proved by results already obtained in Illinois.

The first successful repressuring operation in Illinois was carried out on the Mumford farm, 26-10n-14w, Clark County, in 1921. Between 1921 and 1932 the practice was considerably extended, especially in Clark and Crawford counties.

A systematic investigation of repressuring Illinois oil sands was undertaken in 1932, and the results were published in Illinois Petroleum No. 23. Since that time, additional acreage has been repressured with results which are in line with the average results found by the survey.

In 1932 repressuring had been tried in the southeastern oil fields on 107 leases, 77 of which yielded increased recovery for 1 year or more. The repressured leases had a total area of 11,049 acres by complete farms, of which 3,488 acres had been affected by repressuring.

Out of the 3,488 acres increases in production for 1 year or more were obtained on 2,548 acres or 73 per cent. The total number of input wells was 126, of which 93 were on leases which showed increased production. Out of 613 pumping wells, 458 or 75 per cent showed increased production.

The daily average production of the 458 wells, which was 0.73 bbl. before repressuring, was increased to 1.21 bbl. for an average period of $5\frac{1}{2}$ years, or an increase of 66 per cent. These wells have produced 1,111,392 bbl. of oil as against a production of 668,440 bbl., which would have been the total production for a similar period of time at the rate before repressuring was applied, so that the difference of 442,952 bbl. may be credited to the process.

The greatest percentage of increase in oil production due to repressuring was obtained in the Robinson sand in Crawford County. Numerous leases have been repressured for periods as long as 8 to 10 years, and the average rate of production during this long period has been held above the rate previous to repressuring. The average volume of air or gas used per barrel of increased production from this sand was 8,000 cu. ft.

Success in the Robinson sand augurs well for extension of repressuring to the very similar Bridgeport sand in Lawrence County, which covers 6,000 acres and has not been tested as yet.

One repressured lease producing from the Biehl sand in the Allendale field, Wabash County, gave 57 per cent increased recovery for a 3-year period. Other plants installed on this sand since also have been successful. The average volume of air or gas required per barrel of increased oil production has been low, as have been the pressures required.

For the Casey sand in Clark County the oil recoveries have been less, and the volumes of air or gas required have been nearly double the Robinson sand figures.

Repressuring would be an obvious procedure in this emergency were it not for lack of necessary steel, especially for engines, compressors, and pumps. No doubt with the rubber shortage many large size automobile engines, some of which are already in the field, will be available for oilfield power. There is an acute shortage of compressors and pumps. Compressors now in use in small natural-gasoline plants in the southeastern Illinois field might be adapted for use in repressuring with a minimum requirement of additional steel. Efforts are being made to substitute nonmetallic pipe for steel casing and surface pipe. A higher price for crude would encourage these operations. Illinois operators have often been wasteful of natural reservoir energy, which has left a great amount of oil in the sands; part of this can be recovered by artificial means.

Water Flooding

Interest in the water flooding of Illinois sands was aroused by obser-

vation of the results of natural and accidental floods at many places and in many different sands, and by the unusually large returns from those pools which produced oil accompanied by a large volume of water.

It has been found that accidental floods have produced more than 400,000 bbl. of oil up to 1936, and edge-water encroachment in such formations as the McClosky has produced very much larger amounts. A tabulated list of these results of accidental floods is given in the table.

A practical application of the lesson has been made on the Biehl sand at Allendale where intentional flooding has been practiced on five properties with considerable success. One firm is still producing many times its previous amount of oil after 6 years of flooding.

Siggins and Parker Applied Floods

Recently applied floods have been developed in the Siggins and Parker pools. Forty acres of Christman Brothers farm in 13-10n-10e, Cumberland County, Illinois, and 40 acres in 21-11n-14w, Parker Township, Clark County, have been drilled up and prepared for intensive flooding by the Forest Oil Corporation, Bradford, Pa. The depth of the producing sands in the field ranges from 465 to 600 ft. on one farm and from 230 to 350 ft. on the other. The pattern chosen was the five spot, with five input wells drilled on each line enclosing the Siggins tract, and three in the Parker, and the line of input wells extending in a row across the 40. In the center of each square, the corners of which are formed by input wells, a producing well has been drilled. This makes a pattern 330 ft. between water wells and the same distance between producing oil wells in the Siggins and 660 in the Parker. The Siggins 40 contains 25 input wells and 16 oil-producing wells, and the Parker 40 contains 9 water wells and 4 oil wells.

The input wells will be subjected to sufficient water pressure to cause the oil-producing wells to flow.

There will be no brine-disposal system since all brine will be recycled, being readmitted in turn to the oldest part of the flooded territory.

Water for the projects is piped through a 6-in. line from a drilled well in the valley of Hurricane Creek $5\frac{1}{2}$ miles away.

Summary

Gas repressuring has already increased production by about 1,000 bbl. per well in Illinois territory in which it has been tried, and accidental floods have been shown to increase production of wells by an average of 10,000 bbl. each in the cases studied.

If the 10,000 stripper wells in the old field not already affected were put under gas repressuring or flooding and if recoveries averaging 5,000 bbl. per well were obtained, the total would reach the respectable figure of 50,000,000 bbl. To this could be added the far greater amount which is to be expected from secondary recovery of the stripper-well reserve of the new fields.

Sixteen thousand of Illinois' 24,000 wells are strippers. They insure a large recovery. Premature abandonment would present a great waste at any time and particularly in wartime.

Needless to say, gas and its energy should no longer be wasted at a time when oil is ammunition. The wide adoption of repressuring in Illinois would be speeded up by a regulation prohibiting the waste of gas by requiring it to be used or to be returned to the same or another oil-producing zone.

In any case applying secondary recovery of Illinois stripper oil reserve is a sure means of providing more oil to meet the war emergency.