DEPARTMENT OF MINES AND NATURAL RESOURCES

MINES BRANCH

Preliminary Study of the Virden-Roselea Field

Conservation file

PRELIMINARY STUDY OF THE VIRDEN ROSELEA FIELD

TRAFFORD & ASSOCIATES LTD.

R. Pot

August 24th, 1954.
118/54

TRAFFORD & ASSOCIATES LTD.

PRELIMINARY STUDY OF THE VIRDEN ROSELLA FIELD

RESERVOIR ROCK

The Mississippian limestone has been found productive in the porous bands of the so-called Oolitic zone. All or part of this zone is open to the borehole in all productive wells. The average porosity of this zone calculates to 8.70% for permeabilities higher than 0.1 md. and 9.66% for permeabilities higher than 1.0 md. Core analyses of nine producing wells show that 80% of the footage in excess of 0.1 md. has a permeability of over one md. The Oolitic zone consists of several porous beds, each a few feet in thickness, separated by dense limestone. Fracturing is abundant so that it may be assumed that the porous bands are connected with each other. The average total net thickness is about 18 feet.

Above the Oolitic zone the Crinoidal zone is found, some 25 feet in overall thickness. The Crinoidal zone shows identical porosities and permeabilities as the Oolitic section. Only 69% of the cores in excess of 0.1 md. were over one md. So far no proof exists that commercial oil production can be obtained from it, although in more than half of the wells this zone has been left open to the borehole. The average total net thickness is about 14 feet.

Overlying the Crinoidal zone is some 80 feet of denser Mississippian limestone. Porosities are again in the same order as in the Oolitic zone. Permeabilities are lower. Only 36% of the footage with permeabilities in excess of 0.1 md. was over one md. Some ten wells left about 30 feet of this zone uncased, but no production is expected from it.

RESERVOIR CONTENTS

Two bottom hole samples showed that the oil is highly undersaturated. Original pressure at datum (-630') was 976 p.s.i.g. and the saturation pressure at 84° F. is measured at 140 and 170 p.s.i.g. respectively with some 89 cu. ft.

of gas per barrel of residual oil of 35.4° A.P.I. Viscosity of the oil is 3.6 c.p. at original reservoir conditions.

Connate water content of the pore space is estimated at 30%.

BOTTOM HOLE PRESSURES

Original pressures in November 1953 measured from 976 to 978 p.s.i.g. on five adjoining wells, four of Imperial and B.A. Union Grose #1. The Imperial wells showed negligible pressure decline in April 1954 after a total of 50,000 barrels of oil had been produced.

One pressure measurement is available in the east part of the field. Cal. Standard 13-24 showed a shut-in pressure of about 930 p.s.i.g. at -630' after 231 hours build-up.

PRODUCTIVITY INDICES

P.I.'s are available only for the Imperial wells and two adjacent B.A. wells. B.A. Grose #1 well measured a P.I. of 2.15 barrels per day per pound pressure drawdown, the remaining wells varied between 21 and 50 b/d/p.s.i. The 2.15 b/d/p.s.i. calculates to a permeability of 540 md. for h = 15', u = 3.6 c.p., r_e = 660' and r_w = 0.376'. The others show at least ten times this value.

It was noticed that the core analyses showed horizontal permeability averages of between 0.78 and 100 md. An occasional plug had a permeability in excess of 30 darcies.

RECOVERY MECHANISM

The slight pressure decline for the undersaturated oil points toward pressure maintenance due to water influx.

The strata in which the oil is contained slopes up toward the east and northeast at approximately 30 feet per mile.

The oil water contact, as far as could be determined from the electric logs of wells which drilled that deep, is found to slope at almost the same angle. With the existing vertical fracturing it is expected that the water zone will provide all the characteristics of a bottom water drive, including water coning. That this latter is true is borne out by the fact that some ten wells produce over 10% water, some as high as 65 and 85%.

The recovery efficiency estimate could lead to a good deal of controversy. It would appear that at the moment the oil is produced mainly from the fractures. In order to have a greater movement of oil from the matrix into the fractures a marked pressure differential is required. In the wells, such as the Imperial ones, hardly any pressure differential is observed between flowing and static pressures, while the water appears to replace all the withdrawn oil. B.A. Union Grose #1 had a drawdown pressure of some 65 p.s.i. for a rate of 140 barrels per day. This well produces 22% water! The static pressure has probably remained close to virgin pressure. In both types of wells one may expect to recover but a small percentage of the oil in the matrix and virtually all the oil in the fractures before the wells will go to water. Overall recovery may not exceed 20%.

MAXIMUM PERMISSIBLE RATE DETERMINATION

On the basis of the formula introduced by the Alberta Petroleum and Natural Gas Conservation Board, the M.P.R. calculation for the Oolitic zone would be developed as follows:

Average net productive thickness	= 18'
Average porosity	= 9.66% (in excess of 1.0 md.)
Connate water content	= 30%, estimated
Oil Shrinkage	= 0.95
Recovery	= 20%

Uniform rate life = 10 years

Development Factor = 1.5 (This has been reduced arbitrarily from 2.5 to 1.5. Although the limits of the field are as yet unknown, the interconnection of the developed and undeveloped parts is believed poor and no justification is seen in a factor of 2.5)

The above factors calculate to an M.P.R. of 31 bbls./day.

If it can be shown to the Board's satisfaction that the Crinoidal zone contributes to the production, the M.P.R. for this zone would be developed as follows:

b = 14'; porosity = 9.66%; connate water = 30%; shrinkage = 0.95; recovery = 20%; life = 10 years; development factor = 1.5.

M.P.R. = 24 bbls./day.

The combined M.P.R. would amount to 55 bbls./day.

Present allowable is 100 bbls./day but only few wells are able to produce this. The ones that can are flowing wells and show a high productivity index and low water cut. Pressure information in the pumping wells is scarce so that a comparison cannot be drawn. The lack of information makes it impractical to give individual well M.P.R.'s.

RECOMMENDATIONS

- The Operators should be asked to prepare evidence to show that the Crinoidal zone is capable of commercial oil production.
- The Operators should be asked to prepare evidence to show that a development factor of 2.5 is still warranted.
- Static and flowing bottom hole pressure measurements should be taken at regular intervals, also in pumping wells.

- Water cuts should be watched carefully, especially of the wells with hardly any pressure decline.
- In order to restrict water production to some extent the allowables could be given as "gross" fluid.
- It is felt that 100 bbls./day is too high an M.P.R. with respect to the average well reserves. Assuming that the Crinoidal were equivalent to the Oolitic, recoverable reserves would calculate to 128,000 barrels. Withdrawal rate now is 28.5% annually and upon full development it would still be 11.5% per year which is a rather high rate of withdrawal. If the Crinoidal is not productive, this situation is worse.
- It is recommended that the M.P.R. is set between 50 and 60 barrels per day as an intermediate measure until the Operators have had time to collect the above mentioned evidence.