Raft River, Idaho

LS

GL07282

Slide 1

Intro

- Unconventional
- ~~Post Darcy dd on some not directly propl to Q. [illegible]~~
- theory - laminar flow - dd dir. ppl to Q - negl. well loss
- RR - dd don't follow conventional theoretical values
  - used empirical approach to quantify dd - char.

Slide 2

LOCATION

- between RRGE-2 & RRGP-5 & RRCP-4 - nonprod.
- RRGE-3 on other side of valley.
- ~ 45 % power plant Q ~ 980 gpm.
- 500 HP pumps at 920'
- ~ 277°F WH temp
- better QW than some rising wells.
- ~~Old~~ 157 psig shut in WH press

Slide 3

WELL STATUS

- 13 3/8" csg to 3623'
- TD - 4989'
- 1366' prod. interval
- - in Salt Lake fm.
  - met. rxs
  - qtz monzonite

RIGHT SLIDE 10 FORMULA FOR PRED. . . . . MINUTES

SLIDE 11 DRAWDOWN/REC. VS DISCHG RT AT VARIOUS TIMES

- ~~-~~ s
- ~~-~~ sparse data
- family of curves
- 1000 MIN. BEST DATA FOR ~~WELLFIELD PR~~ LONG TERM PREDICTION

SLIDE 12 S_{10} . . . . . MIN.

- not linear relationship
- perhaps 2 linear segments
- power fn fitted
- slide 10 - LAST PART OF EQN.

SLIDE 13 SUMMARY

Slide 4 FIELD CONDITIONS

Slide 5 CONSTANT DISCHG. VAR. HEAD TEST ~~ANALYTICAL ORS~~

SLIDE 6 GENERAL ANALYTICAL ORS.

RIGHT SLIDE 7 Q/s_{10} POST BOUNDARY VALUES FOR TESTS CONDUCTED

- 26.5 TO 1100 GPM
- SOME QUESTIONABLE VALUES - TESTS FOR OTHER PURPOSES
- CONSIDERABLE DIFFERENCES
- 298 GPM REST TEST
- ALSO 10/20/81 1100 GPM TEST

SLIDE 8 SEMILOG 02/03/82

- RECHG BDRY - 7.3 MIN.

T, S, s_{10}, Q/s_{10} - PRE BDRY

POST BDRY - s_{10} 8.1

Q/s_{10} 26.8

CAL. VALUES - FEW PSI ERROR -

SLIDE 7 - VALUES AV. OF DATA

SLIDE 9 SEMILOG 10/20/81

- Q VAR. PRIOR TO ~100 MIN

s_{10}
Q/s_{10} } DIFFERENT THAN 298 GPM TEST - ~~SLIDE~~ SLIDE 7

(A) PUMPED DRAWDOWN
EARLY TIME (UP TO 600 MIN) ~~TEST~~ DATA ARE OFTEN UNSUITABLE FOR ANALYSIS BECAUSE OF TIME-DEPENDENT CHANGES IN BOREHOLE FLUID TEMPERATURE AND DENSITY PROFILES. IN ADDITION TO OTHER UNKNOWN PHENOMENA AFFECTING DATA (eg FRACTURE CLOSURE). THEREFORE, IT IS DIFFICULT TO DETERMINE ~~UNKNOWN~~ IF EARLY-TIME DRAWDOWN DATA THERE ARE HYDROLOGIC BOUNDARY EFFECTS ~~OR EQUIVALENT~~.

(B) THEORETICAL EQUATIONS ARE FOR ONE PRODUCING ZONE. THE FOLLOWING RRGE-1 HAS 1 PRODUCING ZONES.

(C) THE PRODUCING ~~AND RECEIVING~~ ZONES CAN BE EXPECTED TO POSSESS DIFFERENT
(1) T (kh) VALUES
(2) S (ϕ cH) VALUES
(3) BOUNDARY CONDITIONS
(4) FLUID TEMPERATURES

(D) FRACTURE FLOW IS UNDOUBTEDLY OCCURRING IN AQUIFERS (FAULT SYSTEMS) PENETRATED BY PRODUCTION WELLS. ~~FRACTURE FLOW APPEARS TO BE LESS SIGNIFICANT IN INJECTION WELLS.~~

(E) Q/s_{10} $(Q/\Delta s)_1$ VALUES ~~AND~~ FOR LATE-TIME DATA ARE DEPENDENT ON Q AT RRGE-1 AND RRGE-2. THEREFORE THERE IS PROBABLY NO UNIQUE T (kh) VALUE FOR THE MULTI AQUIFER SYSTEM IN THESE WELLS.

This equation overestimates drawdown, by as much as 15 psi at 1000 min, when the actual drawdown is 437 psi, a 3.4 % error.

6. The skin factor (0.0345) suggests that well losses are negligible at 298 gpm with no significant fracture enlargement near the wellbore.

7. THE REASON(S) FOR THE ABNORMAL LATE-TIME (POST BOUNDARY) DRAWDOWN/RECOVERY SLOPES IS NOT KNOWN BUT MAY BE (SPECULATION) A TURBULENCE INDUCED BOUNDARY.

4) WELLBORE PREHEATING AT LOW FLOW RATES (4-25 GPM) FOR PRIOR TO BEGINNING A INITIATING THE TEST AND DURING RECOVERY SEVERAL DAYS IS NECESSARY TO MINIMIZE BOREHOLE FLUID INDUCED PRESSURE DENSITY EFFECTS BETWEEN THE PRODUCING ZONES AND BOTH ~~ANNULUS~~ THE ER! LOWER END OF THE PRESSURE THE WELLHEAD AND BUBBLER ~~ANNULUS~~ TUBE

5) BEST EARLY-TIME DATA ARE OBTAINED FROM THE RECOVERY PHASE OF A TEST WHILE BEST LATE-TIME DATA ARE OBTAINED FROM THE DRAWDOWN PHASE OF THE TEST EARLY DRAWDOWN AND LATE RECOVERY ~~DTE~~ BECAUSE OF FLUID TEMPERATURE INDUCED PRESSURE CHANGES AND WELLHEAD EARLY DRAWDOWN DISCHARGE RATE STABILIZATION EFFECTS.

6) UNIQUE PROBLEMS WHEN PUMPING RAGE-1 WITH 500 HP PUMP FOR DISCHARGE RATES 800 - 1100 GPM

(a) ANNULUS PRESSURES LAG OPEN BOREHOLE PRESSURES WHEN THE ~~ANNULUS~~ ANNULUS IS BEING DEWATERED DUE TO TIGHT FITTING PUMP IN CASING (~ 1/4" CLEARANCE). THEREFORE EARLY-TIME ~~DTE~~ DRAWDOWN AND RECOVERY PRESSURES INACCURATE WHEN WELL PUMPED. (APPROX 1 ~~DTE~~ MIN WHEN PUMPING DTW 750 FT)

(b) PUMP COLUMN DRAINAGE DURING RECOVERY RESULTS IN ABNORMALLY RAPID PRESSURE RECOVERY IN ~~OPEN~~ BOREHOLE BELOW PUMP.

(c) EARLY-TIME POSSIBLE BOUNDARY EFFECTS ARE INDETERMINABLE ~~DTE~~ HAVE NOT BEEN DETERMINED ~~DTE~~ WHEN WELL IS PUMPED.

4) WELLBORE PREHEAT AND POSTHEAT (<25 GPM).

5) BEST DATA - LATE-TIME DRAWDOWN
- EARLY-TIME RECOVERY

6) UNIQUE PROBLEMS PUMPING AT 800-1100 GPM

a) ANNULUS PRESS. LAG FORMATION PRESS. - TIGHT FITTING PUMP

b) PUMP COLUMN DRAINAGE ~~AFTER~~ (750 FT) AFTER SHUTIN

c) EARLY-TIME PUMPING BOUNDARY EFFECTS NOT DETERMINED

7) GENERALLY Q/s_{10} $(Q/\Delta s)$ VALUES WILL BE USED IN PLACE OF T AND kh VALUES SINCE:

a) ~~EARLY-TIME (UP~~
NONLINEAR DRAWDOWN TRENDS FOR UP TO 600 MIN. ~~PREVENT~~
~~BOUNDARY DELINEATIONS~~

b) ~~STANDARD EQUATIONS ARE FOR ONE PRODUCTION ZONE~~ RRGE-1 HAS SEVERAL (~5) ~~MULTIPLE~~ PRODUCING ZONES ~~WITH PRESUMED DIFFERENT~~
~~HYDRAULIC CHARACTERISTICS AND BOUNDARIES~~

c) A SHUT IN WELLHEAD ~~AN UPWARD DIRECTED~~ RESULTS IN UPWARD FLOW IN OPEN WELLBORE (DISCHARGE AREA)

d) FRACTURE FLOW IS OCCURRING IN FAULT SYSTEMS PENETRATED BY RRGE-1, RRGE-2, AND RRGP-5

e) Q/s_{10} $(Q/\Delta s)$ FOR LATE-TIME FOR RRGE-1 AND ~~RRGE-2~~ RRGE-2 AS WELL AS EARLY-TIME FOR RRGP-5 ARE DEPENDENT ON Q - NO UNIQUE T AND/OR IDEAL BOUNDARY BEHAVIOR.

CONCLUSIONS

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1) PREBOUNDARY (t OR $t' < 10$ MIN) TRANSMISSIVITY WHEN/AFTER ~~UNDER~~ PUMPING INDETERMINATE

2 BOUNDARY ~~EFFECTS~~ EFFECTS OCCUR LATTER FOR DRAWDOWN THAN RECOVERY DATA

slide

3) Q/s_{10} IS NOT A CONSTANT FOR LATE-TIME (POST BOUNDARY) DATA (PERHAPS DUE TO TURBULENT FRACTURE FLOW)

4) CALCULATED DRAWDOWN/RECOVERY ~~BETWEEN~~ ~~AS EARLY AS APPROX. 3 MIN. AND~~ TO AT LEAST 55,000 MIN (38 DAYS).

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$$D/R = 0.0068573\ Q^{1.579632} + (0.0017957411\ Q^{1.4559065584})(\log t - 3)$$

where

D/R = drawdown/recovery for t and/or $t' \geq 200$ min, and possibly as early as 3 min. psi

Q = discharge rate, gpm

t = time since pumping began/ended, min.

5) EQUATION ERRORS ARE APPROX. 15 PSI (3.4%) WHEN 437 PSI OF DRAWDOWN AFTER 1000 MIN FOR 3.4% ERROR.

(6)

FIGURE 12

EQUATION USED TO PREDICT DRAWDOWN/RECOVERY VALUES

$$D/R = 0.0068573\ Q^{1.579632} + (0.0017957411\ Q^{1.4559065584})((\log t)-3)$$

where

D/R = drawdown/recovery for t and/or t' ≥ 200 min, psi

Q = discharge rate, gpm

t = time since pumping began/ended, min.