Denne rapport tilhører
STATOIL
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Returneres etter bruk

IONS

WELL HISTORY

OBJECTIVES OF ANALYSIS AND INSTRUMENTATION

METHOD OF ANALYSIS

NORSK SHELL A.S.

WELL NO: 31/2-14

MAY - JUNE 1984

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WELL SUMMARY

FOR

NORSKE SHELL A.S.

WELL NO: 31/2-14

MAY - JUNE 1984

PARTICLE SIZE ANALYSIS

IN

COMPLETION BRINES

FOR

NORSKE SHELL A.S.

WELL NO: 31/2-14

MAY - JUNE 1984

CONCLUSIONS AND RECOMMENDATIONS
WELL HISTORY
OBJECTIVES OF ANALYSIS AND INSTRUMENTATION
METHOD OF ANALYSIS

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CONCLUSIONS AND RECOMMENDATIONS

The brine analysis of well 31/2-14 was carried out in a thorough style with a completely informative outcome. The representatives of Norske Shell were, at all times, presented with information (verbal and graphical) gained from the analysis and were kept advised of the effectiveness of the filtering operation, as reflected by the analysis.

The analysis and resultant graphs show the clear trends of hole cleaning and particle removal during circulation through the filtration equipment, strongly emphasising the advantages of using the type of instrumentation operated on this well. This is particularly enforced by the instance at the end of the first brine circulation (graphs 2.a,b. and c) where the use of a COULTER COUNTER clarified a possible, misleading situation, thus saving expensive rig time.

It was also seen that a slower flow rate while pumping acid through the well seemed to have a more effective action, by allowing a longer contact time during which the acid could chemically perform.

It is therefore recommended that the particle analysis instrumentation and engineers of I.D.F. are used during similar, future operations.where the cleanliness of a completion brine is of prime importance.

WELL HISTORY

Name:	31/2-14
Operator:	Norske Shell A.S.
Drilled:	April 1984 - May 1984
Contractor:	Dolphin Drilling A.S.
Casing Depths:	30" @ 464 M 20" @ 799 M 13-3/8" @ 1498M 9-5/8" Liner @ 1724M

The well was drilled between April and May 1984 by BORGNY DOLPHIN and the objective was to test between 1583M and 1590M

All depths measured from RKB of BORGNY DOLPHIN.

OBJECTIVES OF ANALYSIS AND INSTRUMENTATION

The cleanliness of a brine is of paramount importance in order to minimise formation damage by solids contamination and to give accurate results during production testing. The particle content of a brine can be analysed by looking at both the number of particles and the size distribution of these particles. By continously monitoring the brine with a COULTER COUNTER and TURBIDITY METER, while circulating, it is possible to determine how clean the brine is, going into and coming out of the well and also the efficiency of the filtration equipment used to clean the brine.

The TURBIDITY METER will give a qualitative indication of the number of particles in the brine. This method measures the intensity of reflection of a light source after passing a cell containing a sample of brine. A light is passed upwards through the cell and the amount of light reflected by particles, at 90° to the lightpath, is measured by a photocell at the side of the sample cell. The light intensity and thus turbidity (related directly to the number of particles) of a sample, is expressed in Nephelometric Turbidity Units (N.T.U.).

The size distribution and a qualitative indication of the number of particles in a brine can be measured by the COULTER COUNTER. The brine sample is mixed in an electrolyte solution and the particles are drawn by vacuum through a small aperture in an insulating barrier between two electrodes, between which flows a small electric current. As each particle traverses the aperture if momentarily increases the resistance between the electrodes and this electric modulation is sensed as a voltage pulse, proportional to the size of the particle. By altering the sensitivity of the instrument it is possible to select a particle size below which, particles are not counted, thus building a distribution starting from a count of the largest particles and finishing with the smallest size that the instrument can be calibrated for. The pulses at these selected sizes are recorded on a digital counter and then analysed for size distribution.

METHOD OF ANALYSIS

The TURBIDITY METER was calibrated to its maximum reading of a scale 0 - 100 N.T.U. as most of the readings were in that range.

The COULTER COUNTER was operated with an orifice aperture diameter of 70 µm giving a measurable size range of 42 µm to 1.7 µm. The clean electrolyte used was a mixture of 70:30 distilled water and brine and this was filtered down to 0.45 µm (twice) to remove as many background particles as possible.

A constant dilution of 3.0 ml of brine sample in 100 ml of clean electrolyte was used at each measurement in order to give an indication of the efficiency of the cleaning process as the circulations progressed. Although different dilutions give the same size distributions for a given sample, a change in the concentration of brine sample in electrolyte will give a corresponding change in the count at each particle size measured e.g. 2.0 ml of brine in 100 ml of electrolyte will give approximately twice the count at all size levels, that 1.0 ml of the same brine sample in 100 ml of electrolyte would give. Thus a constant dilution can give both the particle size distribution and a qualitative indication of cleaning efficiency, against time.

The sizes studied during each analysis were 19.8 µm or greater, 10.1 µm or greater, 5.1 µm or greater and at the most sensitive setting of 1.7 µm or greater, giving the maximum particle count. A count was recorded for each size range and the size distribution was calculated as being the proportion/percentage of particles of each size out of the maximum count of 1.7 µm. This method of particle count/number analysis results in a similar but much quicker calculation of size distribution than the more complicated method of particle volume analysis and is more suited to the immediate needs of analysis while circulating.

RESULTS AND GRAPHS

1. This was a seawater circulation to clean the well prior to displacement of $CaCl_2$ brine at 1.15 S.G. The turbidity readings were taken after two viscous pills and one acid pill were circulated through the well. When the turbidity reached 10 N.T.U. it was decided that no further improvement could be made and the well was displaced to brine.

2. (Three graphs over 48 hours). After displacement the brine was circulated and filtrated in order to clean it to as low a level of particle content as possible. This process proved to be very difficult with the brine taking a large amount of mud and rust particles from the wall. A number of operations were carried out to counter this, starting with pulling the string out of the hole to the liner lap and circulating at this depth. After a lack of success the string was then pulled to the B.O.P. stack where continued circulation showed a good improvement. After running into the bottom to break circulation once more, the wall would not clean up and the string was again pulled to the liner lap and the well displaced to seawater which cleaned to 8 N.T.U.

   An acid slug and viscous slug were pumped and chased slowly (pump rate of 2-3 bbls/min) by brine whilst re-displacing the well. The acid returns to surface were coloured yellow followed by dark green brine returns and then very rusty brine. Brine circulation continued for a further 14 hours and the brine gradually cleaned up to a satisfactory level. Although the turbidity showed a fairly high 23 N.T.U., the COULER COUNTER indicated a very low total particle count with only 5 percent of these particles greater in size than 5.1 μm and never more than 2.9 percent greater in size than 10.1 μm. This indicated that the particles creating a high turbidity were too small to be sensed by the COULTER COUNTER (i.e. smaller than 1.7 μm) and too small to be filtered out.

3. This graph shows the result of a short circulation through the perforation string to clean it and the glass disc in the ported sub. The volume circulated was approximately 80 barrels and therefore all samples collected were from the riser, showing a number of rusty particles.

4. This graph represents the circulation before the gravel pack. The well was previously reverse circulated to clean out a chalk pill and as much formation oil as possible. However, a large amount of oil and gas came to the surface after normal circulation commenced (but before 'bottoms up') and the brine also contained a great number of fine rust and white coloured particles. These reduced in number on addition of concentrated acid to a sample, reducing the turbidity and particle count dramatically, indicating that most of the solids were acid-soluble chalk particles.

NOTES:

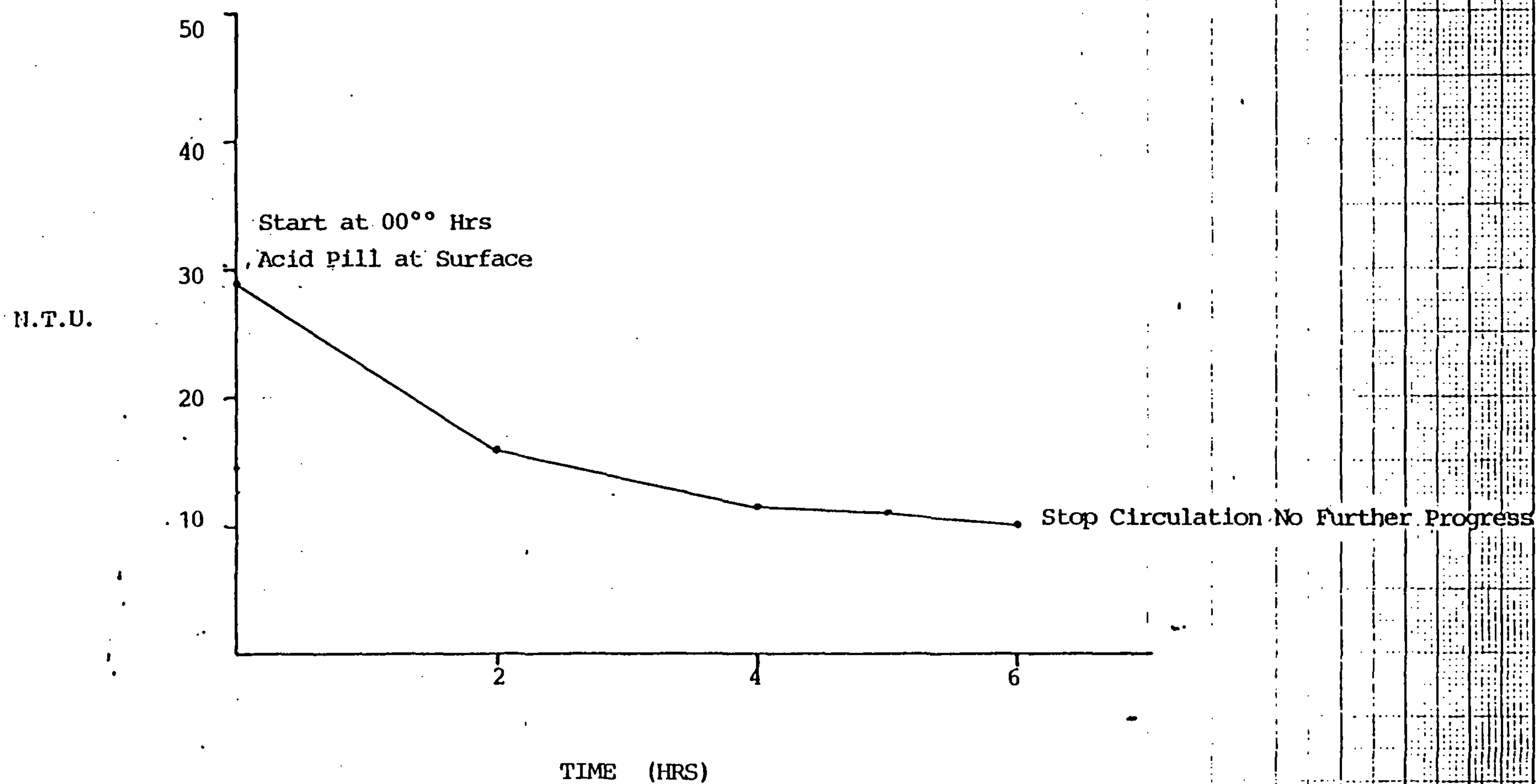
1. For the purpose of clarity in the summary the results and graphs have been based on samples taken from the flow line. However, samples were taken from the outlet of the filtration equipment in order to estimate its efficiency and the results showed turbidity of less than 4 N.T.U. a maximum count under 35 and no particles greater than 5.1 μm in diameter. This treated brine was subsequently circulated down hole. It is therefore reasonable to believe that the brine at the zone to be tested was of a very similar nature and that the brine tested at the flow line contained solids accumulated from circulation in the other parts of the well.

Results And Graphs (Cont'd)

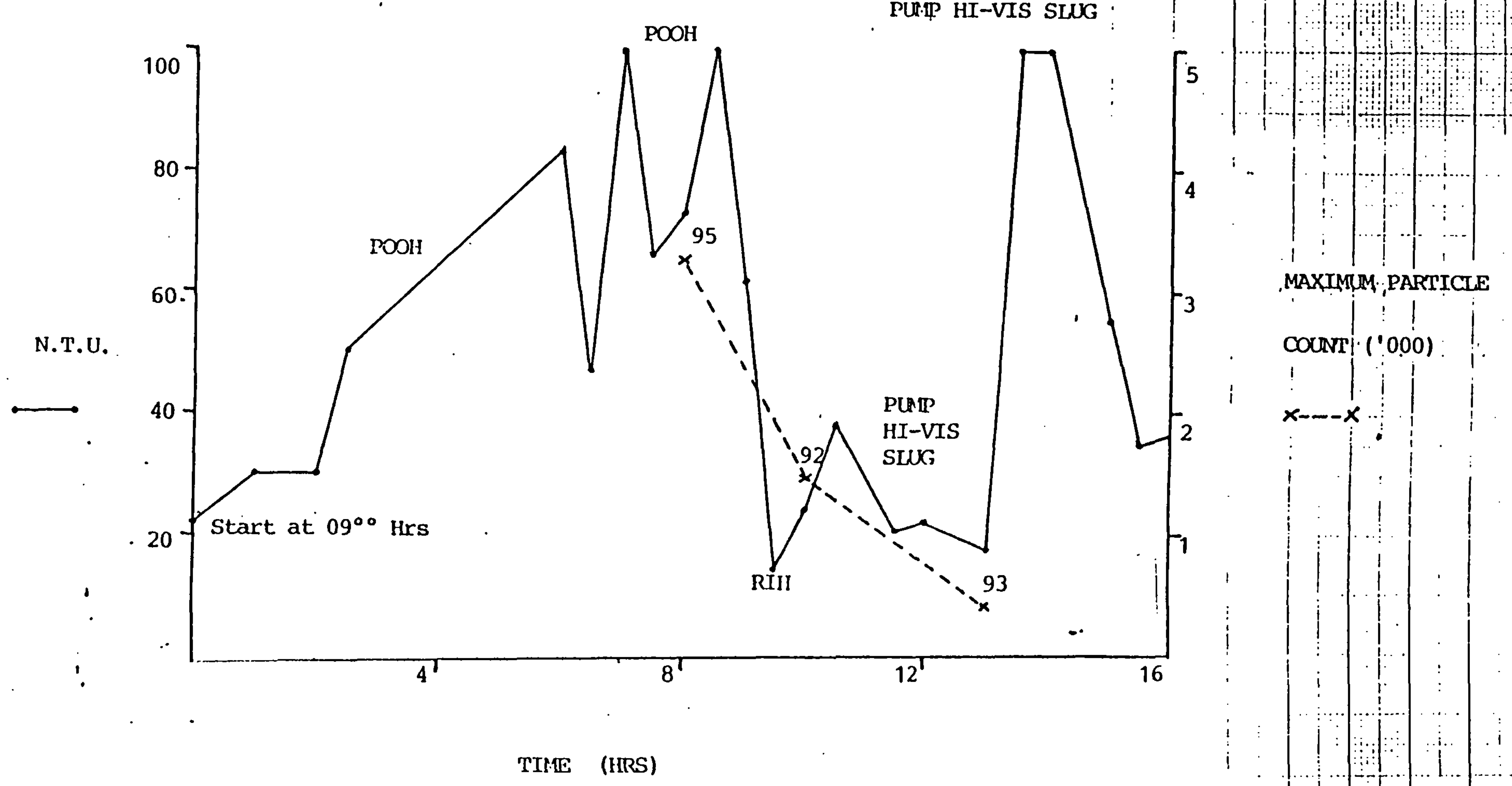
Notes (Cont'd):

2. The figures printed close to the crosses on the graphs (the maximum particle count for each sample) represents the percentage of the maximum count whose size lies in the range 5.1 µm to 1.7 µm.

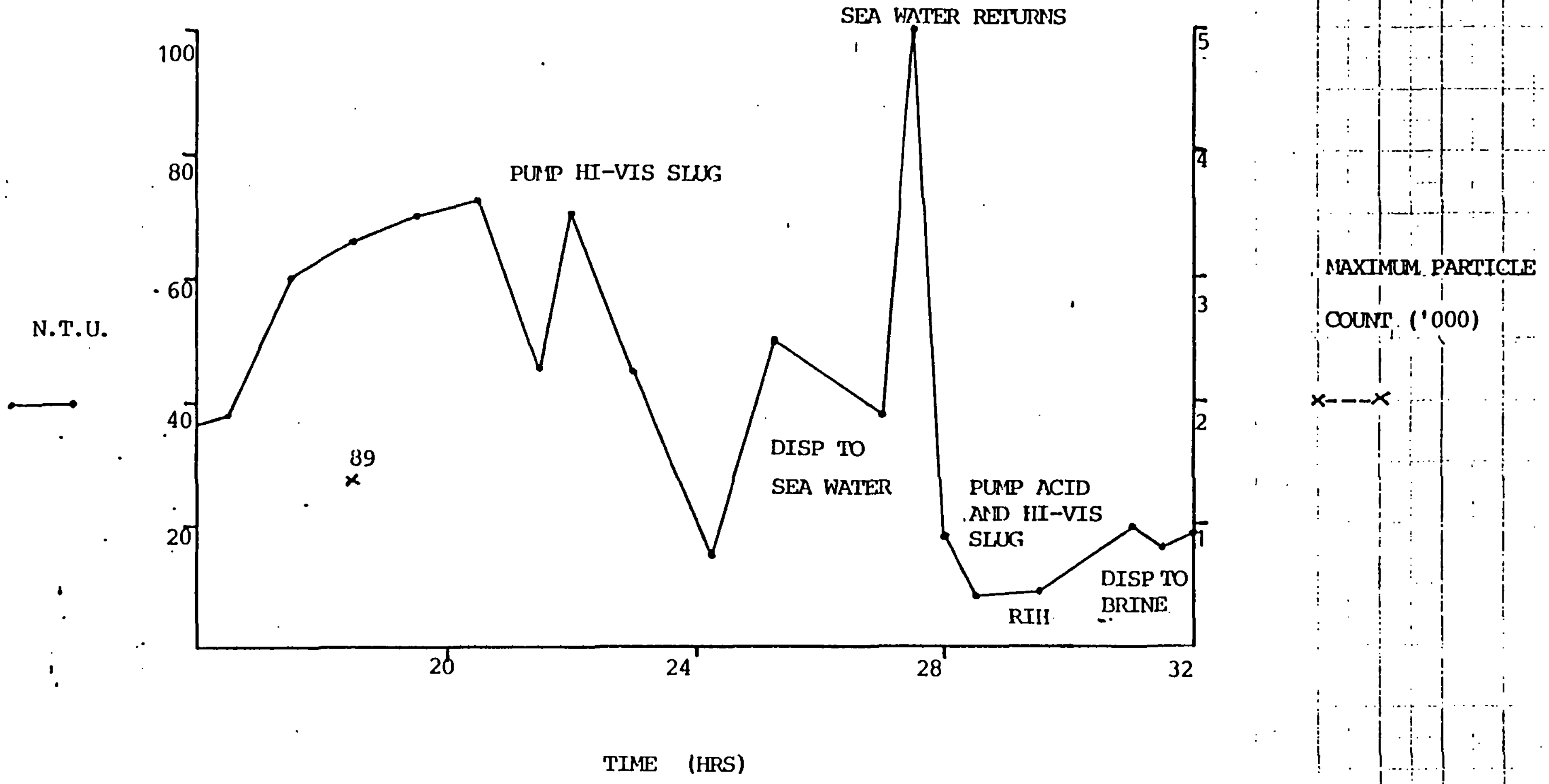
1. SEAWATER CIRCULATION 28/5/84



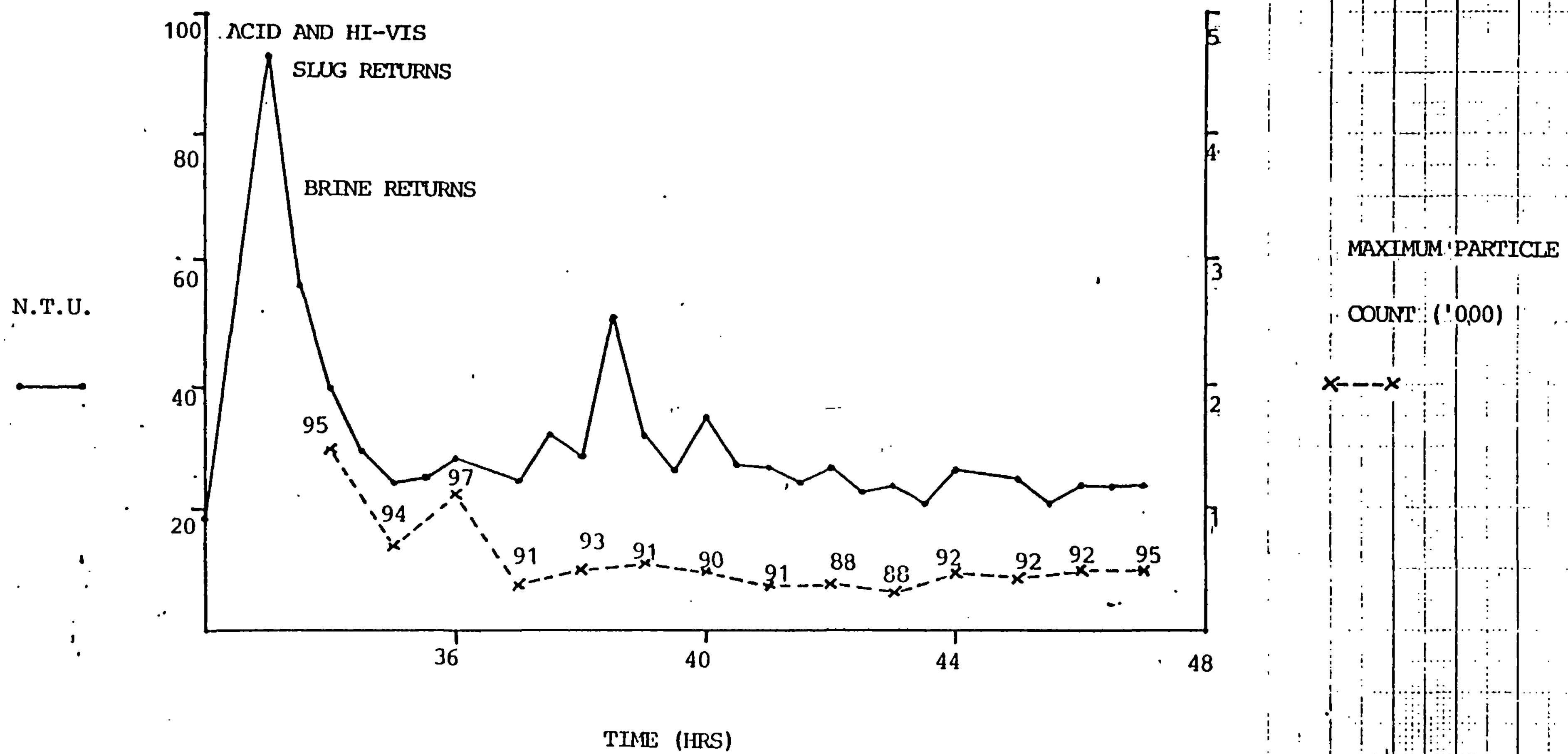
2a FIRST BRINE CIRCULATION 28/5/84



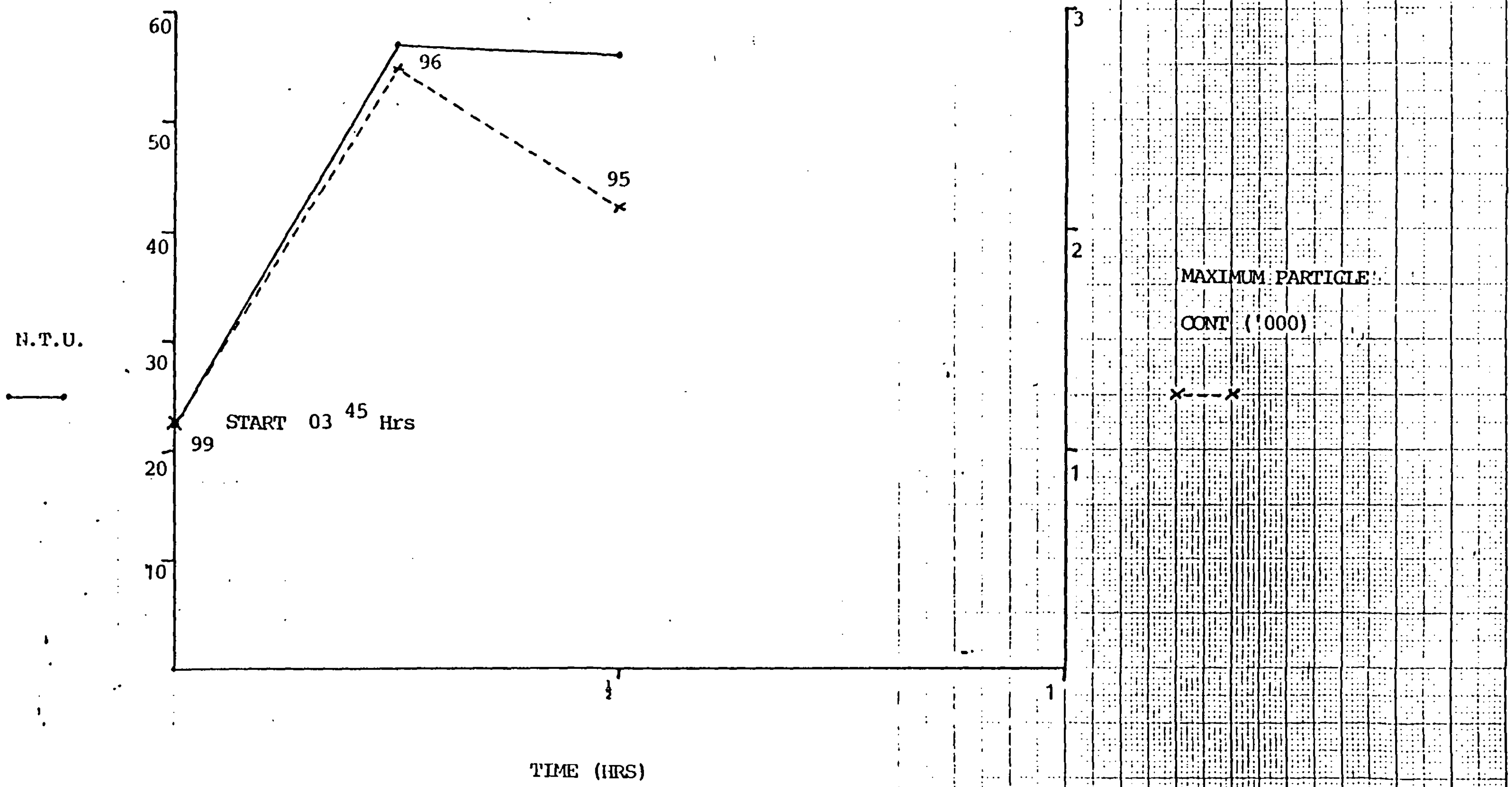
2.b. FIRST BRINE CIRCULATION (CONT'D)



2.c FIRST BRINE CIRCULATION (CONT'D)



3. SECOND BRINE CIRCULATION



4. THIRD BRINE CIRCULATION