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AEC RESEARCH AND DEVELOPMENT REPORT

PREDICTED PERFORMANCE OF GS PROCESS WITH SUPPLEMENTARY FEED TO THE HOT TOWER

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DU PONT

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PREDICTED PERFORMANCE OF GS PROCESS WITH SUPPLEMENTARY FEED TO THE HOT TOWER

by

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ABSTRACT

Calculations predict that a 10 to 11% increase in heavy water production can be achieved by adding a second water feed stream to the GS process first stage. The second feed stream would be pumped to that tray in the first stage hot tower where the heavy water concentrations of the feed and process liquors nearly match. Design criteria for selecting secondary feed rates and the feed tray were developed to guide a proposed plant evaluation. The calculations were made with a mathematical model of the heavy water processes programmed for the IBM System/360-65 computer.

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INTRODUCTION

Heavy water is extracted from clarified river water in the 400 Area of the Savannah River Plant by a dual temperature H_2S exchange process.[1] Figure 1 is a schematic diagram of the process. River water is normally fed only to the top tray of the first stage cold towers, and it then cascades down the tower countercurrent to an H_2S gas stream. The effluent water is heated and then fed to the top of the hot towers where it cascades down and countercurrent to a hot H_2S gas stream. The hot tower effluent water is discarded to waste.

Deuterium concentrates at the cold tower - hot tower junction as shown with a typical concentration gradient of the first stage (Figure 2). The actual extraction of deuterium occurs only in the lower 25% of the first stage hot tower, i.e., from the bubble cap tray where the normal concentration gradient matches the river water concentration to the bottom tray which releases the water to waste. All other trays in the so-called extraction towers and in the distillation towers are used to enrich the deuterium concentration from 0.0147 to 99.75 mol % D_2O.

To increase the production of D_2O from the Savannah River Plant, D. F. Babcock suggested feeding additional river water to the lower portion of the hot tower where the D_2O concentration falls below that of river water. Calculations were made to approximate the gains in D_2O production that would accompany this addition. The Atomic Energy Commission has filed a patent application on the process improvement.

In this study, the gains were calculated as a function of the supplementary feed rate using a mathematical model of the heavy water processes at the Savannah River Plant. Design criteria were also calculated for a confirming plant scale test of this suggestion.

SUMMARY

The addition of feedwater to the lower portion of the hot tower of the GS system will increase the quantity of D_2O extracted from the river water by about 10% when the amount of supplementary water is one-third of that fed to the top of the cold tower.

This gain can be increased to more than 11% by the addition of very large amounts of water, but the addition of more water is not economically attractive. Estimates indicate that if supplementary water to the hot tower is one third of that fed to the cold tower, the unit cost of producing heavy water at the Savannah River Plant can be reduced by about 5%.

The optimum feed point for the addition is that tray in the hot tower where the D_2O concentration in the tower, with the addition, is the same as in the river water. Selection of the feed tray is important; however, the optimum tray depends on the feed rate, and some compromise will be necessary in the proposed plant test. A single feed point at tray number 25 (15 actual trays about the humidifier section) was recommended. The expense for installing multiple feed points in the existing plant is not warranted, but might be considered in new plant design.

When extra feed is added, the optimum liquid-to-gas ratio in the first stage of the extraction process will be about 4% less than the present value and less fluctuation will be tolerable; however, existing control techniques will be adequate.

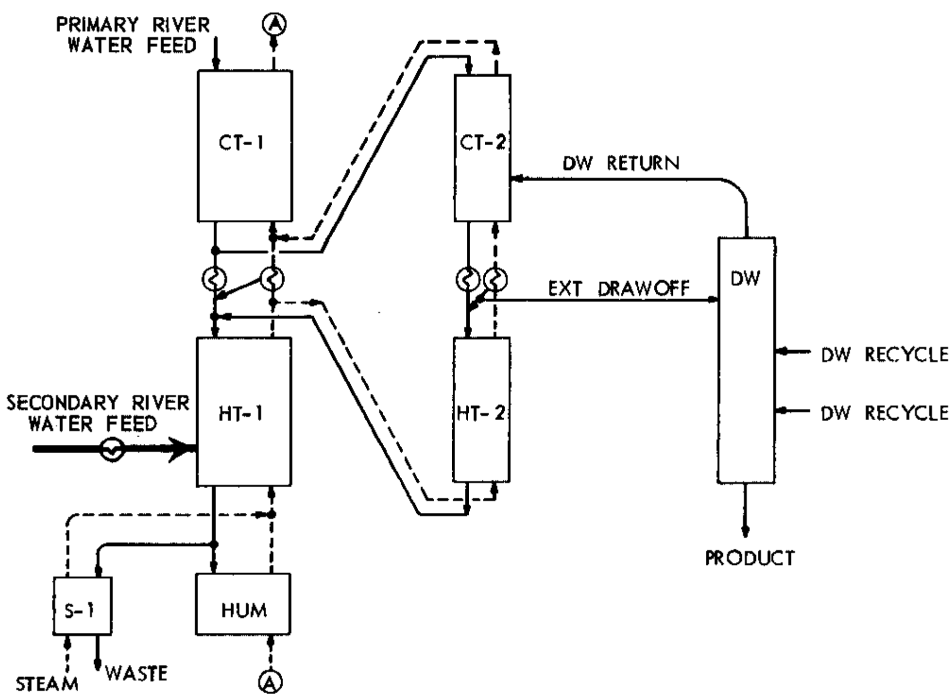

FIG. 1 PROPOSED PROCESS WITH TWO FEED STREAMS

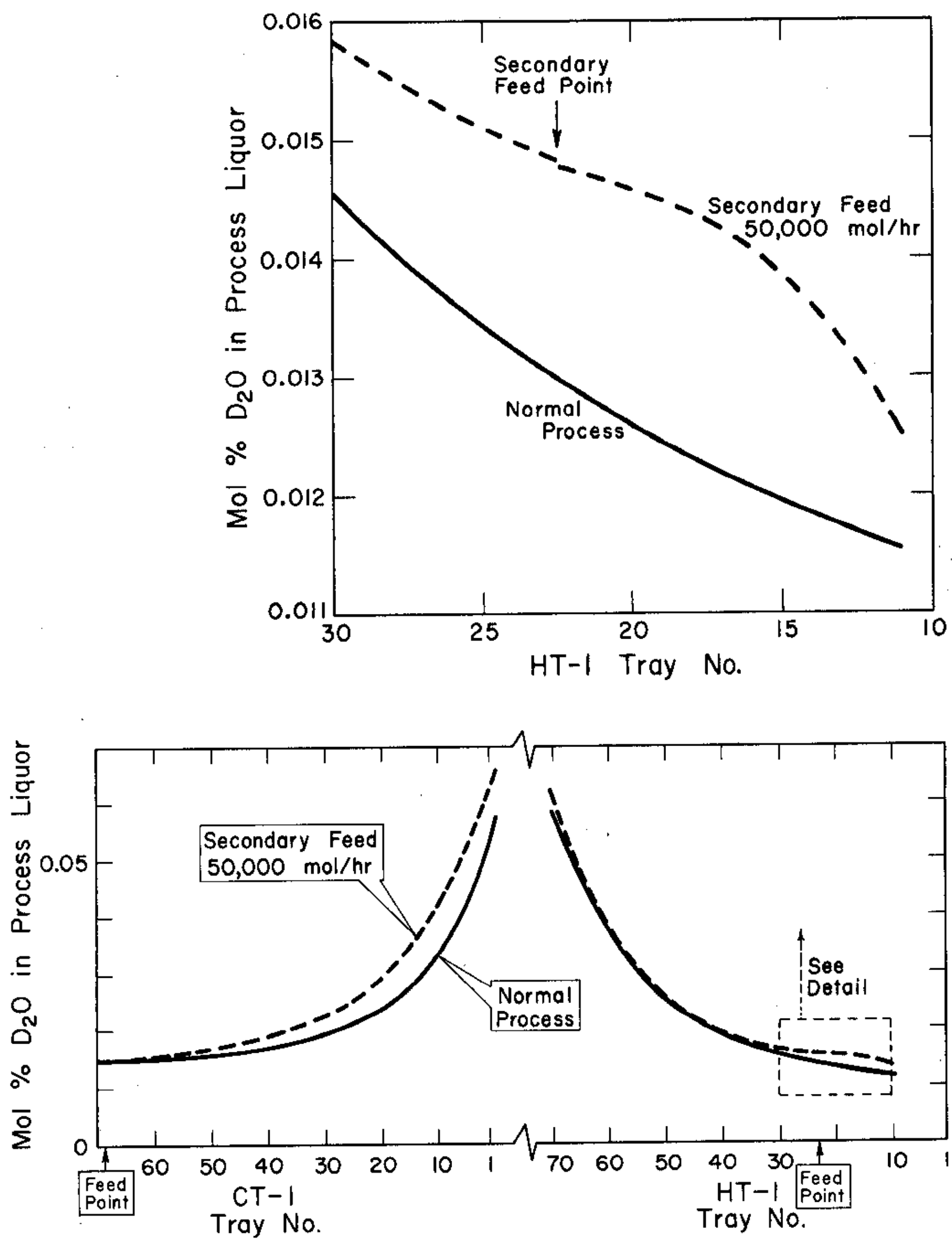

FIG. 2 FIRST STAGE CONCENTRATION GRADIENT

DISCUSSION

A mathematical model[2] of the heavy water processes at the Savannah River Plant was previously programmed in FORTRAN IV for the IBM System/360-65. With a few changes, this program was used for all calculations.

Model Changes

The following changes were made to improve correspondence of calculated and plant performance and to simulate the proposed process change.

Better agreement was obtained between the calculated and measured plant concentration gradients by changing some of the tray efficiencies in the model. The first stage extraction efficiencies were not changed, but the values for the second stage hot and cold towers were changed from 55 and 71% respectively, to 39 and 57% based on some unpublished work in 1955-56 by W. C. Scotten and C. G. Waite (Du Pont - SRP) which correlated efficiencies and plant concentration gradients. The tray efficiencies for the distillation towers, calculated in the program with the A.I.Ch.E. method[3], were decreased by specifying temperature and pressure conditions at each tower top instead of each tower midpoint. The data in Table 1 show the new efficiencies and the improved agreement between measured and calculated concentration gradients.

Calculation of the relative concentrations of condensate and process gas at the exit of the gas coolers was reviewed because the effect of simplifying assumptions on interstage concentrations was questioned. Although this relationship could be improved with integration of the liquid and gas deuterium concentrations as the gas cooled and water vapor condensed, a simple average seemed adequate for this work, so at equilibrium:

$$X = Y\overline{\beta}/(1 - Y + Y\overline{\beta})$$

or

$$Y = X/(\overline{\beta} + X - X\overline{\beta})$$

where

X = the atom fraction deuterium in the condensate

Y = the atom fraction deuterium in the gas leaving the exchangers

$\bar{\beta}$ = an assumed average value of the equilibrium constant

TABLE 1

Efficiencies To Match Gradients

	Plant Data (1/7/69)	Previous Efficiencies	Current Efficiencies
Murphree Tray Efficiency			
Extraction			
CT-1	-	0.59	0.59
HT-1	-	0.71	0.71
CT-2	-	0.55	0.39
HT-2	-	0.71	0.57
Distillation			
EP-7	-	0.623	0.706
EP-4	-	0.918	0.706
EP-30	-	0.779	0.553
EP-50	-	0.732	0.449
EP-70	-	0.739	0.482
EP-90	-	0.759	0.575
Concentration Gradient (mol % D_2O)			
Feed	0.0147	0.0147	0.0147
CT-1 Base	0.064	0.049	0.0613
CT-2 Base	12.00	9.34	13.32
Distillate	9.8-10.2	4.67	9.7
EP-7 Base	31.6-33.9	10.46	35.02
EP-4 Base	76.9	37.26	77.84
EP-30 Base	93.1	77.49	93.68
EP-50 Base	97.63	94.42	97.66
EP-70 Base	99.23	98.86	99.19
EP-90 Base	99.78	99.78	99.78

Calculation results with $\bar{\beta}$ equal to β at cold tower temperature, at hot tower temperature, and the average of these two $\bar{\beta}$'s are shown in Table 2. The average β closely corresponded to a β calculated at the temperature of the total condensate in the collection tank, and seemed like a reasonable value. However, in the second stage, $\bar{\beta}$ calculated at cold tower temperature gave better correspondence between relative concentrations of the condensate and cold tower effluent. The conditions of Case I were used here. A more rigorous study seemed unnecessary.

TABLE 2

Interstage Concentrations

Case	I	II	III
Temperature	Cold Tower	Condensate	Hot Tower
Assumed β at PC-SC Exit			
Stage 1	2.2726	1.9061[a]	1.5395
Stage 2	2.2685	1.9057[a]	1.5428
Interstage Concentrations			
X_{bc1}	0.0544	0.0576	0.0619
X_{bc1}	0.0260	0.0282	0.0314
X_{tc2}	0.0544	0.0576	0.0619
Y_{tc2}	0.0244	0.0259	0.0279
X_{bh2}	0.0533	0.0536	0.0545
Y_{bh2}	0.0340	0.0341	0.0345
X_{th1}	0.0559	0.0560	0.0567
Y_{th1}	0.0340	0.0341	0.0345
Extraction Drawoff Concentration	10.64	10.64	10.62
Production Rate			
Lb D_2O/Day	1170.8	1170.2	1168.3
Relative (% of Case II)	100.05	100.00	99.84

(a) The arithmetic average of the β for cold and hot towers.

The program was altered to add a preset quantity of heated, H_2S free, river water either at some preset tray number or at that tray which first equaled or had less than the river water concentration as the calculation proceeded tray-to-tray down the tower. It was assumed that the added river water mixed uniformly and became saturated with process gas in the downcomer preceding the feed tray. The liquid rate was increased accordingly for the trays below. Because all dissolved H_2S is returned to the base of the hot tower in this model, the gas dissolved at the feed tray was also recycled, increasing slightly the gas rate in this part of the tower. At the feed tray, then, the liquid-to-gas ratio is changed from

$$\text{RATIO} = L/G$$

to

$$\text{RATIO} = \frac{L + F(1 + S)}{G + FS}$$

and the liquid concentration leaving the feed downcomer is

$$X_n = \frac{LX'_n + F(X_r + Y_n S)}{L + F(1 + S)}$$

and the new operating line intercept is

$$I = X_n - Y_n/\text{RATIO}$$

where

- F = secondary river water feed, mol/hr
- G = gas flow above the feed tray, mol/hr
- L = liquid flow above the feed tray, mol/hr
- S = solubility of H_2S in water, mol H_2S/mol H_2O
- X_r = concentration of deuterium in river water
- X_n = concentration of deuterium in liquor to tray n
- X'_n = concentration of deuterium in liquor from tray n+1
- Y_n = concentration of deuterium in gas leaving tray n
- n = tray number counting up the tower

The calculation then proceeds tray-to-tray down the tower as before. In this model, uniform temperature and pressure were assumed throughout the hot tower as problem conditions and the stripper off-gas including process steam and the recovered H_2S is returned to the gas entering the bottom tray (tray 11). The assumptions simplify the calculation by ignoring undefined transverse and vertical nonuniformities.

Problem Conditions

The conditions of pressure, temperature, flow rate, boilup rate, etc., were specified for each tower from normal plant operating conditions. Several physical properties and flow rates are calculated in the program as a function of the fundamental conditions. These data are listed in the computer printouts in the appendix.

The secondary river water feed rate was varied from 5,000 to 50,000 mol/hr to the hot towers. Eight extraction units are currently operating, each with a first stage cold tower - hot tower pair; the total secondary rate was distributed equally among the eight hot towers. The rate was expressed in mol/hr because tray-to-tray calculations are simpler with these units. The 50,000 rate corresponds to 225 gpm per hot tower; it is about 35% of the total water and process steam fed to each unit and about 45% of the water fed to the top of the hot tower.

In each of the problems solved with the model, sufficient iterations were made to close all material balances around each stage and around the overall process within an acceptable tolerance. The overall D_2O balances are shown in Table 3 to close within 0.03%. The liquid-to-gas ratios in the first and second stage extraction cold towers were adjusted in all problems until the maximum production rate resulted. During this adjustment, the process gas rates were held constant, because these rates are limited in the plant by blower capacity, and the liquor feed rates to the cold towers were varied to achieve the best liquid-to-gas ratios. Thus, the river water feed rate to the first stage cold towers was not necessarily constant in the several problem solutions.

Concentration Gradients

The first stage hot tower has 70 bubble cap trays, but the bottom 10 trays are used for gas heating and humidification. D_2O concentrations of process liquor on the active 60 trays are shown in Figure 2 for normal operation and with a secondary feed rate of 50,000 mol/hr. The tray with deuterium concentration matching the river water varied with the secondary feed rate from tray 30 down to tray 22, as shown in Table 4.

TABLE 3

Overall Material Balances
(All Flows in mol/hr)

Secondary Feed	None	5000	10000	20000	30000	40000	50000
Feed (0.0147%)							
To CT-1	77333	76343	75733	74997	74721	74550	74377
To HT-1	0.	5000	10000	20000	30000	40000	50000
Steam	13521	13467	13435	13395	13380	13371	13362
Total Input							
Liquor	90854	94810	99168	108392	118101	127921	137739
D_2O	13.356	13.937	14.578	15.934	17.361	18.804	20.248
Waste							
Liquor	90851	94808	99165	108390	118098	127918	137735
Mol % D_2O	.01202	.01206	.01213	.01228	.01245	.01261	.01275
D_2O	10.920	11.434	12.029	13.310	14.703	16.130	17.561
Product (99.79%)							
Liquor	2.4397	2.5053	2.5567	2.6240	2.6612	2.6834	2.6954
D_2O	2.4346	2.5000	2.5513	2.6185	2.6556	2.6778	2.6898
Total Output							
Liquor	90853	94811	99168	108393	118101	127921	137738
D_2O	13.355	13.934	14.580	15.929	17.359	18.808	20.251
Closure of D_2O Balance	0.01%	0.02%	0.01%	0.03%	0.01%	0.02%	0.02%

TABLE 4

Calculated Concentration Gradients
(mol % D_2O)

Secondary Feed, mol/hr	None	5000	10000	20000	30000	40000	50000
DW Process							
Stage 5, Base	99.78	99.78	99.78	99.78	99.78	99.78	99.78
Stage 4, Base	98.88	98.89	98.89	98.90	98.91	98.91	98.91
Stage 3, Base	96.26	96.32	96.37	96.42	96.45	96.47	96.49
Stage 2, Base	89.44	89.66	89.84	90.06	90.18	90.25	90.30
Stage 1, Base	66.02	66.69	67.12	67.89	68.25	68.47	68.61
Stage 1, Mid	23.84	24.44	24.92	25.55	25.90	26.11	26.25
Stage 1, Distillate	7.01	7.23	7.40	7.62	7.75	7.82	7.87
GS Process							
CT-2 Top, Gas	0.0259	0.0268	0.0274	0.0283	0.0289	0.0291	0.0293
Liquor	0.0576	0.0596	0.0611	0.0631	0.0643	0.0648	0.0652
CT-2 Base, Gas	5.880	6.053	6.191	6.373	6.475	6.535	6.575
Liquor	11.725	12.067	12.327	12.667	12.879	13.003	13.081
HT-2 Top, Gas	6.795	6.992	7.149	7.356	7.471	7.539	7.585
Liquor	11.377	11.705	11.958	12.289	12.488	12.605	12.680
HT-2 Base, Gas	0.0341	0.0348	0.0354	0.0363	0.0367	0.0371	0.0373
Liquor	0.0536	0.0548	0.0558	0.0572	0.0578	0.0584	0.0587
CT-1 Top, Gas	0.00638	0.00639	0.00639	0.00640	0.00641	0.00641	0.00641
Feed Liquor	0.0147	0.0147	0.0147	0.0147	0.0147	0.0147	0.0147
CT-1 Base, Gas	0.0212	0.0289	0.0295	0.0302	0.0306	0.0319	0.0311
Liquor	0.0576	0.0596	0.0611	0.0631	0.0643	0.0648	0.0652
HT-1 Top, Gas	0.0341	0.0348	0.0354	0.0363	0.0367	0.0371	0.0373
Liquor	0.0560	0.0575	0.0588	0.0605	0.0613	0.0619	0.0623
HT-1 Base, Gas	0.00742	0.00744	0.00746	0.00751	0.00756	0.00760	0.00764
Liquor	0.0115	0.0116	0.0117	0.0119	0.0121	0.0123	0.0125
Waste Liquor	0.01202	0.01206	0.01213	0.01228	0.01245	0.01261	0.01275
HT-1 Tray with Matching % D_2O	30	29	28	26	24	23	22

This table also shows the calculated plant concentration gradients at several secondary rates. Only minor changes occurred on important concentrations, such as the first and second stage drawoff concentration in extraction, and no operating difficulty is expected from these concentration levels.

The effect of the secondary feed is illustrated with McCabe-Thiele diagrams in Figures 3 and 4. The secondary feed changed the slope of the operating line between trays 22 and 11 so that a greater driving force was available for concentration. With optimum liquid-to-gas ratios, the waste water concentration is greater with secondary feed, but more water is processed through these trays and the net quantity of D_2O extracted is greater.

Production Rate

The heavy water production rate is shown in Figure 5 as a function of the secondary feed rate. In each of the solutions for this curve, the river water was fed to the tray which best matched the river water concentration. Although the gain is diminishing with each increment of feed, the extraction rate was increased by more than 10% when 225 gpm were fed to the hot towers.

Feed Tray

Multiple feed points would be extraordinarily expensive to install in the existing operating plant so calculations were made at various rates and feed points to seek a compromise. The results, shown in Figure 6, indicate that the ideal feed point varied with secondary feed rate but that nearly all of the production rate gain can be realized if the feed tray is ±3 trays from ideal. This model assumed uniform temperature and pressure on each of the hot tower trays, but the actual towers have measurable transverse and vertical temperature gradients from trays 11 through 20. This non-uniformity must decrease their effectiveness; and consequently, the best feed tray in the plant is likely to be higher than that calculated with this model. Tray 25, therefore, appears to be a good selection.

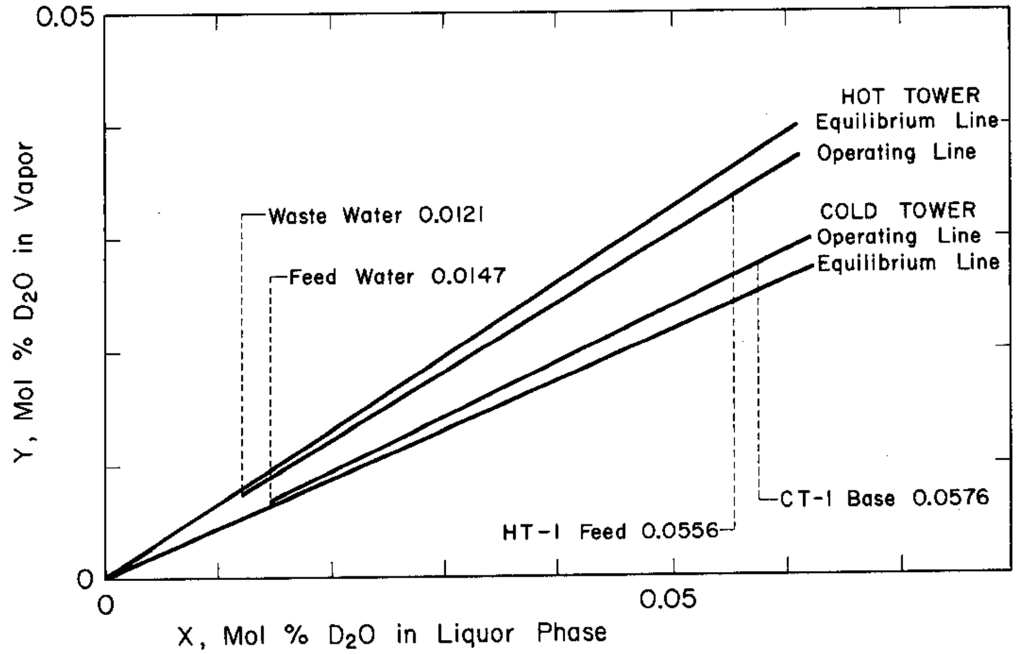

FIG. 3 McCABE-THIELE DIAGRAM OF NORMAL FIRST STAGE

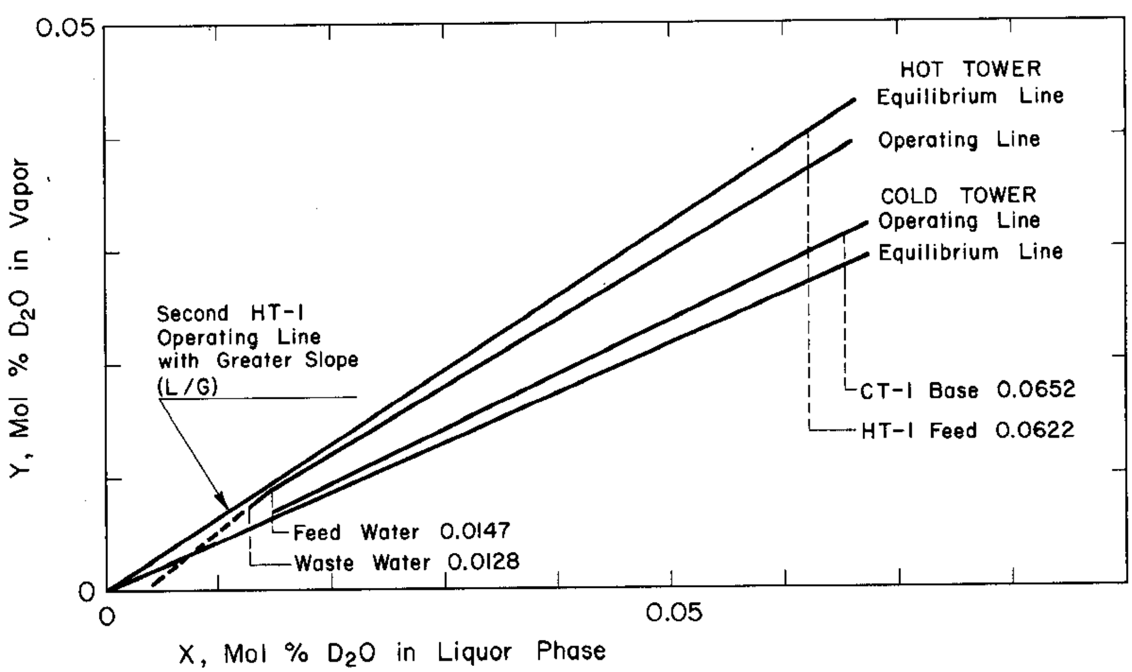

FIG. 4 McCABE-THIELE DIAGRAM OF PROPOSED FIRST STAGE

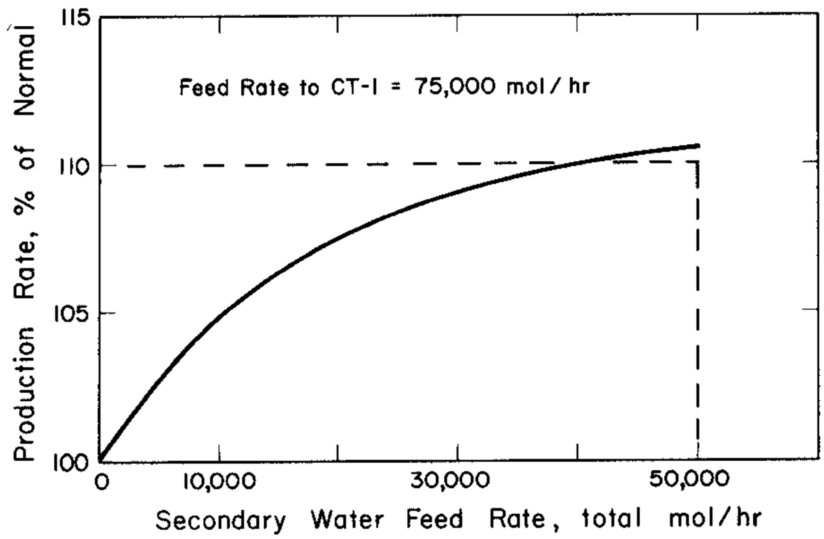

FIG. 5 PRODUCTION RATE GAIN

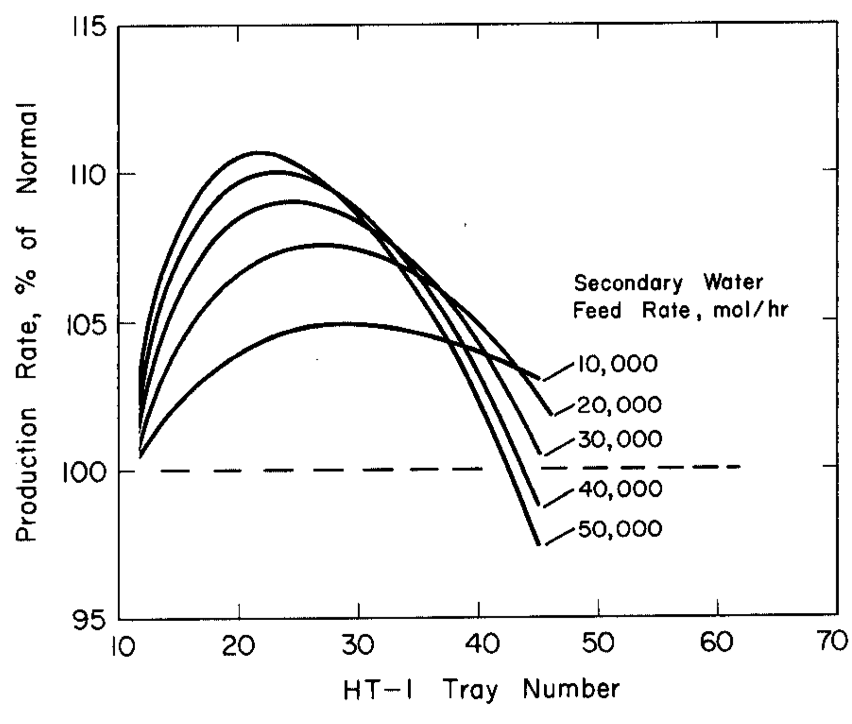

FIG. 6 IMPORTANCE OF FEED TRAY SELECTION

Process Control

Control of the liquid-to-gas ratio was studied to anticipate any plant problems. The production rate was calculated with various secondary feed rates and with a number of first stage cold tower liquid-to-gas ratios. The results, shown in Figure 7, illustrate the great importance of liquid-to-gas ratio control in this process. With secondary feed, the optimum occurs at a slightly lower ratio than normal, and the shape of the curve indicates a little less room for control variation, but it is believed that existing control techniques[4] will suffice.

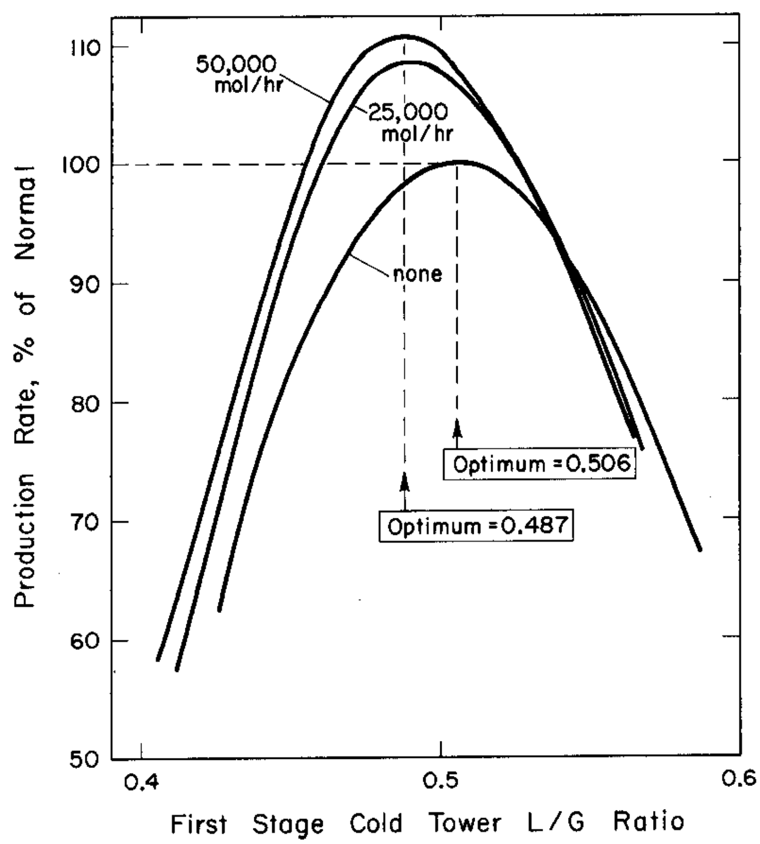

FIG. 7 IMPORTANCE OF L/G CONTROL

Previous Design Assumptions

As stated in DP-400,[1] some assumptions were necessary during plant design to position the operating lines of the first stage cold and hot towers. These assumptions are compared with calculation results from this model simply for academic interest.

It was assumed during design that:

The ratio of the slope of the hot equilibrium line to the slope of the hot operating line equals the ratio of the slope of the cold operating line to the slope of the cold equilibrium line.

A similar equality exists between the ratios of actual and equilibrium compositions at the top of the cold tower and bottom of the hot tower. The ratio of these compositions was guessed to be 0.98 for design.

The validity of the assumptions has been amply demonstrated by successful plant operation, but the calculations here may sharpen any future design assumptions. The results are shown in Tables 5 and 6. The approach of the actual gas concentration to the equilibrium concentration was surprisingly close in both the cold and hot towers (0.998 and 0.989), especially at the top of the cold tower. Curved equilibrium lines were used in the model, whereas straight lines were assumed during design, but the effect of the slight curvature is negligible. The shift in the operating lines with increased secondary feed, shown in columns 2 and 3, reflects the shift necessary to optimize the liquid-to-gas ratio.

Detailed Results

As a matter of record, computer printouts for problem conditions and results, including all concentration gradients, are included in the appendix both for the current normal condition and for the proposed process with 225 gpm of secondary feed. At each tray number, the X and Y concentrations for a tray number represent the concentration of liquid to a tray and the concentration of gas leaving the tray, so that these data pairs define the operating line at each tray. Similarly, the X and EQ-Y or Y and EQ-X data points describe the equilibrium lines at each tray. The tray numbers shown correspond to actual plant tray numbers, always counting up the towers. The other data are believed to be sufficiently defined on the printouts.

TABLE 5

Operating and Equilibrium Line Relationships

Secondary Feed, mol/hr	CT-1 $L\beta/G$	HT-1 $G/L\beta$	CT-1 $X_t/\beta Y_t$	HT-1 $\beta Y_b/X_b$
None	1.149	1.083	0.9981	0.9893
5000	1.135	1.092	0.9971	0.9857
10000	1.126	1.098	0.9962	0.9808
20000	1.115	1.105	0.9947	0.9696
30000	1.111	1.108	0.9940	0.9583
40000	1.108	1.110	0.9935	0.9483
50000	1.106	1.111	0.9930	0.9399

TABLE 6

Closeness Of Some
1950-52 Design Assumptions

Secondary Feed, mol/hr	$\frac{L_c\beta_c}{G_c}$	=	$\frac{G_h}{L_h\beta_h}$	$\frac{X_{tc1}}{\beta_{c1}Y_{tc1}}$	=	$\frac{\beta_h Y_{bh}}{X_{bh}}$
None	1.149	=	1.083 [(a)]	0.998	=	0.989 [(b)]
5000	1.135		1.092	0.997		0.986
10000	1.126		1.098	0.996		0.981
20000	1.115		1.105	0.995		0.970
30000	1.111		1.108	0.994		0.958
40000	1.108		1.110	0.994		0.948
50000	1.106		1.111	0.993		0.940

(a) These two values were assumed to be equal for design.

(b) These two values were assumed equal to 0.98 for design.

REFERENCES

1. W. P. Bebbington and V. R. Thayer. Production of Heavy Water, Savannah River and Dana Plants. USAEC Report DP-400, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, S. C. (1959).

2. M. P. Burgess. A Mathematical Model of Heavy Water Extraction and Distillation. USAEC Report DP-____, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, S. C. (to be issued).

3. Bubble Tray Design Manual, A.I.Ch.E. (1958).

4. J. W. Morris and W. C. Scotten. "Control of the Dual Temperature Exchange Process for the Manufacture of Heavy Water." *Chem. Eng. Progr. 58* (39), 26 (1962).

5. J. F. Proctor. "Sieve and Bubble Plates, Comparative Performance." *Chem. Eng. Progr. 59* (3), 47-54 (1963).

APPENDIX A

NORMAL PROBLEM CONDITIONS AND RESULTS

DW PLANT TOWER		EP-90	EP-70	EP-50	EP-30	EP-4	EP-7
HEAD PRESS.	MM HG	60.0	60.0	60.0	80.0	259.7	110.0
TOWER DP	MM HG	229.3	297.9	321.0	275.2	193.9	149.7
BASE PRES.	MM HG	289.3	357.9	381.0	355.2	453.6	259.7
VAPOR RATE	MOL/HR	170.0	230.0	250.0	410.0	880.0	880.0
EFFICIENCY, EMV		0.5746	0.4818	0.4493	0.5525	0.7056	0.7056
F-FACTOR AT TOP		1.2213	1.6523	1.7960	1.6453	0.6649	0.6391

CW FEED FROM EXTN	62.440 MOL/HR	0.1064	MOL FR D20
DW RECYCLE FEED 1	0.LBS/DAY	0.0	MOL FR D20
DW RECYCLE FEED 2	0.LBS/DAY	0.0	MOL FR D20
DW RECYCLE FEED 3	0.LBS/DAY	0.0	MOL FR D20

EXTRACTION AREA TOWER		CT-1	HT-1	CT-2	HT-2
NO. OF EXTRACTION UNITS		8.			
GAS FLOW PER UNIT	LB/HR	668000.		186000.	
TOWER TOP LIQUOR FEED	MOL/HR	77333.			
TOTAL EXIT GAS FLOW	MOL/HR	157176.	194166.	43765.	54186.
TOWER TOP LIQUOR RATE	MOL/HR	79502.	116489.	21933.	32353.
LIQUOR ADDED OR RECYCLED	MOL/HR		0.	60.	0.
TRAY NUMBER			30	39	118
L/G AT TOWER TOP		0.5058	0.5999	0.5012	0.5971
L/G AT TOWER BASE		0.5058	0.5999	0.5026	0.5971
ESTIMATED STEAM INPUT	MOL/HR		13520.7		
STRIPPER OFF-GAS RATE	MOL/HR		14396.3		
STRIPPER OFF-GAS MOL % D20			0.01148		
WASTE WATER RATE	MOL/HR		90851.		
WASTE WATER MOL % D20			0.01202		
PRESSURE	PSIA	295.	320.	265.	300.
TEMPERATURE	DEGREES C	32.0	144.0	33.0	142.0
BETA		2.2726	1.5395	2.2685	1.5428
EMV OR EML		0.590	0.710	0.390	0.570
HUMIDITY	MOL H2O/MOL H2S	0.00351	0.24810	0.00393	0.24970
SOLUBILITY	MOL H2S/MOL H2O	0.02804	0.00964	0.02456	0.00911

PRODUCTION RATE	MOL D20/HR	LB D20/DAY
CALCULATION BASIS IN EXTN		
1ST STAGE OP LINES	0.24345D 01	0.11702D 04
2ND STAGE OP LINES	0.24345D 01	0.11702D 04
NET FWC FEED TO DW	0.24346D 01	0.11702D 04
TOTAL RCYL FED TO DW	0.0	0.0
TOTAL DW DRAWOFF RATE	0.24346D 01	0.11702D 04

NORMAL DW PLANT SEPARATION FACTORS - ABOVE TRAYS

TRAY COUNTING UP	EP-90	EP-70	EP-50	EP-30	EP-4	EP-7
84					1.04179	
83					1.04165	
82					1.04152	
81					1.04140	
80					1.04127	
79					1.04114	
78					1.04102	
77					1.04090	
76					1.04078	
75					1.04066	
74					1.04054	
73					1.04043	
72	1.06135	1.06135	1.06135	1.05752	1.04031	1.05327
71	1.06016	1.05954	1.05931	1.05647	1.04020	1.05298
70	1.05913	1.05809	1.05772	1.05554	1.04008	1.05269
69	1.05822	1.05687	1.05640	1.05471	1.03997	1.05242
68	1.05740	1.05582	1.05528	1.05396	1.03986	1.05215
67	1.05665	1.05489	1.05431	1.05327	1.03975	1.05189
66	1.05596	1.05406	1.05344	1.05264	1.03965	1.05163
65	1.05533	1.05331	1.05266	1.05205	1.03954	1.05138
64	1.05475	1.05263	1.05195	1.05150	1.03944	1.05114
63	1.05420	1.05200	1.05130	1.05098	1.03933	1.05090
62	1.05368	1.05141	1.05069	1.05050	1.03923	1.05067
61	1.05319	1.05086	1.05013	1.05004	1.03913	1.05044
60	1.05273	1.05035	1.04961	1.04960	1.03903	1.05022
59	1.05230	1.04987	1.04911	1.04918	1.03893	1.05001
58	1.05188	1.04941	1.04865	1.04879	1.03883	1.04979
57	1.05149	1.04898	1.04821	1.04841	1.03873	1.04959
56	1.05111	1.04857	1.04779	1.04805	1.03863	1.04938
55	1.05074	1.04818	1.04739	1.04770	1.03854	1.04918
54	1.05040	1.04780	1.04701	1.04737	1.03844	1.04899
53	1.05006	1.04745	1.04665	1.04704	1.03835	1.04880
52	1.04974	1.04710	1.04630	1.04673	1.03825	1.04861
51	1.04943	1.04677	1.04597	1.04643	1.03816	1.04842
50	1.04913	1.04645	1.04565	1.04614	1.03807	1.04824
49	1.04883	1.04615	1.04534	1.04586	1.03798	1.04807
48	1.04855	1.04585	1.04504	1.04559	1.03789	1.04789
47	1.04828	1.04557	1.04475	1.04533	1.03780	1.04772
46	1.04802	1.04529	1.04447	1.04507	1.03771	1.04755
45	1.04776	1.04502	1.04420	1.04482	1.03762	1.04738
44	1.04751	1.04476	1.04394	1.04458	1.03754	1.04722
43	1.04726	1.04451	1.04368	1.04435	1.03745	1.04706
42	1.04703	1.04426	1.04344	1.04412	1.03736	1.04690
41	1.04680	1.04402	1.04320	1.04389	1.03728	1.04674
40	1.04657	1.04379	1.04296	1.04367	1.03719	1.04659
39	1.04635	1.04357	1.04273	1.04346	1.03711	1.04644
38	1.04614	1.04334	1.04251	1.04325	1.03703	1.04629
37	1.04593	1.04313	1.04230	1.04305	1.03695	1.04614
36	1.04572	1.04292	1.04208	1.04285	1.03686	1.04600
35	1.04552	1.04271	1.04188	1.04265	1.03678	1.04585
34	1.04533	1.04251	1.04168	1.04246	1.03670	1.04571
33	1.04513	1.04232	1.04148	1.04227	1.03662	1.04557
32	1.04495	1.04213	1.04129	1.04209	1.03655	1.04544
31	1.04476	1.04194	1.04110	1.04191	1.03647	1.04530
30	1.04458	1.04175	1.04092	1.04174	1.03639	1.04517
29	1.04440	1.04157	1.04073	1.04156	1.03631	1.04503
28	1.04423	1.04140	1.04056	1.04139	1.03624	1.04490
27	1.04406	1.04122	1.04038	1.04123	1.03616	1.04477
26	1.04389	1.04105	1.04021	1.04106	1.03608	1.04465
25	1.04373	1.04089	1.04005	1.04090	1.03601	1.04452
24	1.04357	1.04072	1.03988	1.04074	1.03593	1.04440
23	1.04341	1.04056	1.03972	1.04059	1.03586	1.04427
22	1.04325	1.04040	1.03956	1.04044	1.03579	1.04415
21	1.04310	1.04025	1.03941	1.04029	1.03571	1.04403
20	1.04295	1.04010	1.03925	1.04014	1.03564	1.04391
19	1.04280	1.03995	1.03910	1.03999	1.03557	1.04380
18	1.04265	1.03980	1.03896	1.03985	1.03550	1.04368
17	1.04251	1.03965	1.03881	1.03971	1.03543	1.04357
16	1.04236	1.03951	1.03867	1.03957	1.03536	1.04345
15	1.04222	1.03937	1.03853	1.03943	1.03529	1.04334
14	1.04209	1.03923	1.03839	1.03930	1.03522	1.04323
13	1.04195	1.03909	1.03825	1.03916	1.03515	1.04312
12	1.04182	1.03896	1.03812	1.03903	1.03508	1.04301
11	1.04168	1.03883	1.03798	1.03890	1.03501	1.04290
10	1.04155	1.03869	1.03785	1.03877	1.03495	1.04280
9	1.04142	1.03857	1.03773	1.03865	1.03488	1.04269
8	1.04130	1.03844	1.03760	1.03852	1.03481	1.04259
7	1.04117	1.03831	1.03747	1.03840	1.03475	1.04248
6	1.04105	1.03819	1.03735	1.03828	1.03468	1.04238
5	1.04093	1.03807	1.03723	1.03816	1.03461	1.04228
4	1.04081	1.03795	1.03711	1.03804	1.03455	1.04218
3	1.04069	1.03783	1.03699	1.03792	1.03449	1.04208
2	1.04057	1.03771	1.03687	1.03781	1.03442	1.04198
1	1.04045	1.03759	1.03676	1.03770	1.03436	1.04188

NORMAL DW PLANT CONCENTRATIONS, ABOVE EACH TRAY*

TRAY	EP-90 X	EP-90 Y	EP-90 EQ-Y	EP-70 X	EP-70 Y	EP-70 EQ-Y	EP-50 X	EP-50 Y	EP-50 EQ-Y
72	98.920	98.907		96.395	96.359		89.819	89.722	
71	98.949	98.937	98.885	96.477	96.442	96.269	90.021	89.925	89.473
70	98.977	98.965	98.916	96.555	96.521	96.357	90.211	90.117	89.690
69	99.003	98.992	98.945	96.629	96.595	96.440	90.392	90.300	89.893
68	99.029	99.018	98.973	96.700	96.667	96.519	90.565	90.475	90.086
67	99.053	99.043	99.000	96.768	96.735	96.593	90.732	90.643	90.269
66	99.077	99.067	99.025	96.833	96.801	96.665	90.892	90.805	90.445
65	99.100	99.090	99.050	96.895	96.865	96.733	91.047	90.962	90.613
64	99.121	99.112	99.073	96.956	96.926	96.799	91.197	91.113	90.776
63	99.143	99.133	99.096	97.015	96.985	96.862	91.342	91.260	90.933
62	99.163	99.154	99.118	97.071	97.042	96.924	91.483	91.402	91.085
61	99.183	99.174	99.139	97.126	97.098	96.983	91.620	91.540	91.233
60	99.202	99.193	99.160	97.179	97.151	97.040	91.753	91.675	91.375
59	99.220	99.212	99.179	97.231	97.204	97.095	91.883	91.806	91.514
58	99.238	99.230	99.199	97.281	97.254	97.149	92.009	91.933	91.649
57	99.255	99.248	99.217	97.330	97.303	97.201	92.132	92.057	91.781
56	99.272	99.265	99.235	97.377	97.351	97.252	92.252	92.179	91.909
55	99.289	99.281	99.253	97.423	97.398	97.301	92.369	92.297	92.034
54	99.305	99.298	99.270	97.468	97.443	97.349	92.484	92.412	92.155
53	99.320	99.313	99.286	97.512	97.487	97.396	92.595	92.525	92.274
52	99.335	99.329	99.302	97.554	97.531	97.441	92.704	92.635	92.390
51	99.350	99.343	99.318	97.596	97.572	97.485	92.811	92.743	92.503
50	99.364	99.358	99.333	97.636	97.613	97.528	92.915	92 848	92.614
49	99.378	99.372	99.347	97.676	97.653	97.570	93.018	92.951	92.722
48	99.391	99.386	99.362	97.714	97.692	97.611	93.117	93.052	92.828
47	99.404	99.399	99.376	97.752	97.730	97.651	93.215	93.151	92.931
46	99.417	99.412	99.389	97.789	97.768	97.690	93.311	93.248	93.033
45	99.430	99.425	99.402	97.825	97.804	97.729	93.405	93.343	93.132
44	99.442	99.437	99.415	97.860	97.839	97.766	93.497	93.435	93.229
43	99.454	99.449	99.428	97.894	97.874	97.802	93.587	93.526	93.324
42	99.465	99.461	99.440	97.928	97.908	97.838	93.675	93.615	93.417
41	99.477	99.472	99.452	97.961	97.941	97.872	93.762	93.703	93.508
40	99.488	99.483	99.464	97.993	97.974	97.906	93.847	93.789	93.598
39	99.499	99.494	99.475	98.024	98.006	97.940	93.930	93.873	93.685
38	99.509	99.505	99.486	98.055	98.037	97.972	94.011	93.955	93.772
37	99.519	99.515	99.497	98.085	98.067	98.004	94.092	94.036	93.856
36	99.529	99.526	99.508	98.115	98.097	98.035	94.170	94.115	93.939
35	99.539	99.536	99.518	98.144	98.126	98.066	94.248	94.193	94.020
34	99.549	99.545	99.528	98.172	98.155	98.096	94.323	94.270	94.100
33	99.558	99.555	99.538	98.200	98.183	98.125	94.398	94.345	94.178
32	99.567	99.564	99.548	98.227	98.211	98.153	94.471	94.419	94.255
31	99.576	99.573	99.558	98.254	98.237	98.182	94.543	94.491	94.330
30	99.585	99.582	99.567	98.280	98.264	98.209	94.613	94.563	94.404
29	99.594	99.591	99.576	98.306	98.290	98.236	94.682	94.633	94.477
28	99.602	99.600	99.585	98.331	98.315	98.262	94.750	94.701	94.548
27	99.611	99.608	99.593	98.355	98.340	98.288	94.817	94.769	94.618
26	99.619	99.616	99.602	98.379	98.365	98.314	94.883	94.835	94.687
25	99.627	99.624	99.610	98.403	98.388	98.339	94.948	94.901	94.755
24	99.634	99.632	99.618	98.426	98.412	98.363	95.011	94.965	94.822
23	99.642	99.640	99.626	98.449	98.435	98.387	95.074	95.028	94.887
22	99.649	99.647	99.634	98.472	98.458	98.411	95.135	95.090	94.952
21	99.657	99.655	99.642	98.494	98.480	98.434	95.196	95.151	95.015
20	99.664	99.662	99.649	98.515	98.502	98.457	95.255	95.211	95.077
19	99.671	99.669	99.657	98.537	98.523	98.479	95.313	95.270	95.138
18	99.678	99.676	99.664	98.557	98.544	98.501	95.371	95.328	95.199
17	99.684	99.683	99.671	98.578	98.565	98.522	95.427	95.385	95.258
16	99.691	99.690	99.678	98.598	98.585	98.543	95.483	95.441	95.316
15	99.698	99.696	99.685	98.618	98.605	98.564	95.538	95.496	95.373
14	99.704	99.703	99.691	98.637	98.625	98.584	95.592	95.551	95.430
13	99.710	99.709	99.698	98.656	98.644	98.604	95.645	95.604	95.485
12	99.716	99.715	99.704	98.675	98.663	98.624	95.697	95.657	95.540
11	99.722	99.721	99.711	98.693	98.682	98.643	95.748	95.709	95.593
10	99.728	99.727	99.717	98.711	98.700	98.662	95.799	95.760	95.646
9	99.734	99.733	99.723	98.729	98.718	98.681	95.849	95.810	95.698
8	99.740	99.739	99.729	98.747	98.735	98.699	95.898	95.860	95.750
7	99.745	99.745	99.735	98.764	98.753	98.717	95.946	95.909	95.800
6	99.751	99.750	99.741	98.781	98.770	98.734	95.994	95.957	95.850
5	99.756	99.756	99.746	98.797	98.787	98.752	96.040	96.004	95.899
4	99.761	99.761	99.752	98.814	98.803	98.769	96.087	96.050	95.947
3	99.767	99.766	99.757	98.830	98.819	98.786	96.132	96.096	95.994
2	99.772	99.771	99.762	98.845	98.835	98.802	96.177	96.141	96.041
1	99.777	99.777	99.768	98.861	98.851	98.818	96.221	96.186	96.087

* FEED TRAYS ARE MARKED WITH AN ASTERISK. ALL CONCENTRATIONS ARE IN MOL % D_2O.

ABOVE BASE 99.782 99.782 99.773 98.876 98.867 98.834 96.264 96.230 96.132

XP = 99.790

TRAY	EP-30 X	EP-30 Y	EP-30 EQ-Y	EP-4 X	EP-4 Y	EP-4 EQ-Y	EP-7 X	EP-7 Y	EP-7 EQ-Y
84				24.582	24.374				
83				24.971	24.763	24.211			
82				25.363	25.157	24.599			
81				25.761	25.556	24.991			
80				26.164	25.959	25.388			
79				26.571	26.368	25.789			
78				26.982	26.780	26.195			
77				27.399	27.198	26.606			
76				27.820	27.620	27.022			
75				28.245	28.047	27.442			
74				28.675	28.478	27.867			
73				29.109	28.913	28.296			
72	66.878	66.682		29.548	29.353	28.730	7.013	7.013	
71	67.453	67.260	66.213	29.991	29.797	29.168	7.259	7.242	6.917
70	68.012	67.823	66.805	30.438	30.246	29.610	7.499	7.466	7.149
69	68.556	68.370	67.379	30.890	30.699	30.057	7.734	7.685	7.375
68	69.087	68.904	67.938	31.345	31.156	30.508	7.962	7.897	7.596
67	69.605	69.426	68.482	31.805	31.616	30.963	8.185	8.105	7.811
66	70.112	69.935	69.013	32.269	32.081	31.423	8.402	8.307	8.021
65	70.607	70.434	69.532	32.736	32.550	31.886	8.613	8.504	8.225
64	71.092	70.922	70.039	33.207	33.023	32.353	8.819	8.696	8.424
63	71.567	71.400	70.535	33.683	33.499	32.824	9.019	8.882	8.618
62	72.033	71.868	71.020	34.161	33.979	33.299	9.213	9.063	8.806
61	72.489	72.327	71.496	34.644	34.463	33.778	9.402	9.239	8.990
60	72.937	72.777	71.962	35.129	34.950	34.260	9.586	9.411	9.168
59	73.376	73.218	72.419	35.618	35.440	34.745	9.765	9.577	9.341
58	73.806	73.652	72.868	36.111	35.934	35.234	9.938	9.739	9.510
57	74.229	74.077	73.307	36.606	36.431	35.727	10.106	9.895	9.673
56	74.644	74.494	73.739	37.105	36.931	36.223	10.269	10.047	9.832
55	75.052	74.904	74.163	37.606	37.434	36.721	10.427	10.195	9.986
54	75.452	75.307	74.578	38.111	37.940	37.223	10.581	10.338	10.135
53	75.845	75.702	74.987	38.618	38.448	37.728	10.727	10.480	10.278
52	76.231	76.091	75.388	39.127	38.959	38.235	10.873	10.626	10.420
51	76.610	76.472	75.782	39.640	39.473	38.745	11.021	10.775	10.564
50	76.983	76.847	76.168	40.154	39.989	39.258	11.172	10.927	10.712
49	77.349	77.215	76.549	40.671	40.507	39.773	11.327	11.082	10.862
48	77.708	77.577	76.922	41.190	41.027	40.290	11.484	11.240	11.016
47	78.062	77.933	77.289	41.711	41.550	40.809	11.645	11.401	11.172
46	78.410	78.282	77.650	42.233	42.074	41.331	11.809	11.565	11.332
45	78.751	78.626	78.004	42.758	42.600	41.854	11.976	11.733	11.495
44	79.087	78.964	78.352	43.284	43.127	42.380	12.147	11.904	11.661
43	79.417	79.296	78.695	43.811	43.656	42.906	12.321	12.078	11.831
42	79.741	79.622	79.031	44.340	44.187	43.435	12.498	12.256	12.004
41	80.060	79.943	79.362	44.870	44.718	43.965	12.679	12.438	12.181
40	80.374	80.258	79.688	45.401	45.251	44.496	12.864	12.623	12.361
39	80.682	80.569	80.007	45.934	45.784	45.028	13.052	12.812	12.544
38	80.985	80.874	80.322	46.466	46.319	45.561	13.245	13.005	12.732
37	81.283	81.173	80.631	47.000	46.854	46.095	13.440	13.201	12.923
36	81.576	81.468	80.935	47.534	47.389	46.630	13.640	13.401	13.117
35	81.865	81.758	81.233	48.069	47.925	47.166	13.844	13.606	13.316
34	82.148	82.043	81.527	48.603	48.461	47.701	14.051	13.814	13.519
33	82.427	82.323	81.816	49.138	48.998	48.238	14.263	14.026	13.725
32	82.700	82.599	82.100	49.673	49.534	48.774	14.479	14.242	13.936
31	82.970	82.870	82.379	50.208	50.070	49.310	14.699	14.463	14.150
30	83.235	83.136	82.654	50.742	50.606	49.846	14.923	14.688	14.369
29	83.495	83.398	82.924	51.276	51.141	50.382	15.151	14.917	14.592
28	83.751	83.656	83.190	51.809	51.676	50.918	15.384	15.150	14.819
27	84.003	83.909	83.451	52.342	52.210	51.453	15.621	15.388	15.051
26	84.251	84.159	83.708	52.874	52.744	51.988	15.862	15.630	15.287
25	84.495	84.404	83.960	53.405	53.276	52.521	16.108	15.876	15.527
24	84.734	84.645	84.208	53.934	53.807	53.054	16.359	16.128	15.772
23	84.970	84.882	84.453	54.463	54.337	53.586	16.614	16.383	16.021
22	85.202	85.115	84.693	54.990	54.866	54.117	16.874	16.644	16.275
21	85.430	85.344	84.929	55.516	55.393	54.646	17.138	16.909	16.533
20	85.654	85.570	85.162	56.040	55.919	55.174	17.407	17.179	16.796
19	85.874	85.791	85.390	56.563	56.443	55.700	17.681	17.453	17.064
18	86.091	86.009	85.615	57.083	56.965	56.225	17.960	17.733	17.337
17	86.304	86.224	85.836	57.602	57.485	56.748	18.243	18.017	17.614
16	86.514	86.435	86.053	58.118	58.003	57.269	18.532	18.306	17.897
15	86.720	86.642	86.267	58.633	58.519	57.788	18.825	18.601	18.184
14	86.923	86.847	86.477	59.145	59.032	58.305	19.123	18.900	18.476
13	87.123	87.047	86.684	59.655	59.544	58.819	19.427	19.204	18.773
12	87.319	87.245	86.887	60.162	60.052	59.331	19.735	19.513	19.075
11	87.512	87.439	87.087	60.667	60.558	59.841	20.049	19.827	19.382
10	87.702	87.630	87.284	61.169	61.062	60.348	20.367	20.147	19.694
9	87.888	87.818	87.478	61.668	61.562	60.853	20.691	20.471	20.011
8	88.072	88.002	87.668	62.164	62.060	61.355	21.019	20.801	20.334
7	88.253	88.184	87.855	62.658	62.555	61.854	21.353	21.136	20.661
6	88.431	88.363	88.039	63.148	63.047	62.350	21.692	21.476	20.994
5	88.605	88.539	88.221	63.635	63.535	62.843	22.037	21.821	21.332
4	88.777	88.712	88.399	64.119	64.020	63.333	22.386	22.172	21.675
3	88.946	88.882	88.574	64.600	64.502	63.819	22.741	22.527	22.023
2	89.113	89.049	88.746	65.077	64.981	64.302	23.101	22.888	22.377
1	89.276	89.214	88.916	65.551	65.456	64.782	23.466	23.254	22.735
ABOVE BASE	89.437	89.376	89.083	66.021	65.927	65.259	23.836	23.626	23.099

NORMAL EXTRACTION TOWER CONCENTRATIONS*

TRAY	CT-2A X	CT-2A Y	CT-2A EQ-Y	CT-2B X	CT-2B Y	CT-2B EQ-Y	HT-2A X	HT-2A Y	HT-2A EQ-X	HT-2B X	HT-2B Y	HT-2B EQ-X
84				0.475	0.235							
83	0.0576	0.0259		0.496	0.246	0.219						
82	0.0580	0.0261	0.0256	0.517	0.256	0.229						
81	0.0584	0.0263	0.0258	0.540	0.268	0.239						
80	0.0588	0.0265	0.0259	0.563	0.279	0.249						
79	0.0593	0.0267	0.0261	0.588	0.292	0.260						
78	0.0598	0.0270	0.0264	0.614	0.305	0.272						
77	0.0603	0.0272	0.0266	0.641	0.318	0.284						
76	0.0608	0.0275	0.0268	0.669	0.332	0.296						
75	0.0614	0.0278	0.0271	0.699	0.347	0.309						
74	0.0620	0.0281	0.0273	0.730	0.363	0.323						
73	0.0626	0.0284	0.0276	0.762	0.379	0.337						
72	0.0632	0.0287	0.0279	0.796	0.396	0.352						
71	0.0639	0.0290	0.0282	0.831	0.414	0.368						
70	0.0646	0.0294	0.0285	0.868	0.432	0.385				0.3680	0.2218	0.3418
69	0.0654	0.0298	0.0288	0.907	0.451	0.402	11.377	6.795	10.110	0.3531	0.2129	0.3281
68	0.0661	0.0302	0.0292	0.947	0.472	0.420	10.655	6.362	9.487	0.3388	0.2044	0.3150
67	0.0670	0.0306	0.0295	0.989	0.493	0.439	9.989	5.964	8.913	0.3252	0.1963	0.3025
66	0.0678	0.0310	0.0299	1.034	0.515	0.458	9.376	5.598	8.382	0.3123	0.1885	0.2906
65	0.0687	0.0315	0.0303	1.080	0.538	0.479	8.809	5.260	7.889	0.2999	0.1811	0.2792
64	0.0697	0.0319	0.0307	1.128	0.562	0.500	8.285	4.947	7.432	0.2881	0.1741	0.2683
63	0.0706	0.0324	0.0312	1.178	0.588	0.523	7.799	4.656	7.007	0.2768	0.1674	0.2580
62	0.0717	0.0329	0.0316	1.231	0.614	0.546	7.347	4.387	6.611	0.2661	0.1610	0.2481
61	0.0728	0.0335	0.0321	1.286	0.641	0.571	6.927	4.136	6.241	0.2558	0.1548	0.2387
60	0.0739	0.0341	0.0326	1.343	0.670	0.597	6.536	3.903	5.896	0.2461	0.1490	0.2297
59	0.0751	0.0347	0.0331	1.403	0.700	0.623	6.171	3.685	5.573	0.2367	0.1434	0.2211
58	0.0764	0.0353	0.0337	1.465	0.731	0.651	5.830	3.481	5.271	0.2278	0.1381	0.2129
57	0.0777	0.0360	0.0343	1.530	0.764	0.680	5.512	3.291	4.988	0.2193	0.1331	0.2051
56	0.0791	0.0367	0.0349	1.598	0.798	0.711	5.213	3.113	4.722	0.2112	0.1282	0.1977
55	0.0805	0.0374	0.0355	1.669	0.833	0.742	4.933	2.946	4.473	0.2035	0.1236	0.1906
54	0.0821	0.0381	0.0362	1.742	0.870	0.776	4.671	2.789	4.238	0.1961	0.1192	0.1838
53	0.0837	0.0389	0.0369	1.819	0.909	0.810	4.424	2.642	4.018	0.1891	0.1150	0.1773
52	0.0853	0.0398	0.0376	1.899	0.949	0.846	4.193	2.503	3.810	0.1824	0.1110	0.1711
51	0.0871	0.0407	0.0384	1.982	0.990	0.883	3.975	2.373	3.615	0.1759	0.1071	0.1652
50	0.0889	0.0416	0.0392	2.068	1.034	0.922	3.770	2.251	3.430	0.1698	0.1035	0.1596
49	0.0909	0.0426	0.0401	2.158	1.079	0.963	3.576	2.135	3.257	0.1640	0.1000	0.1542
48	0.0929	0.0436	0.0410	2.252	1.126	1.005	3.394	2.026	3.092	0.1584	0.0967	0.1490
47	0.0950	0.0446	0.0419	2.349	1.174	1.049	3.222	1.924	2.937	0.1531	0.0935	0.1441
46	0.0973	0.0458	0.0429	2.450	1.225	1.095	3.060	1.829	2.794	0.1480	0.0904	0.1395
45	0.0996	0.0469	0.0439	2.555	1.278	1.143	2.908	1.739	2.657	0.1431	0.0875	0.1350
44	0.1021	0.0482	0.0450	2.664	1.332	1.192	2.765	1.653	2.528	0.1385	0.0848	0.1307
43	0.1046	0.0495	0.0462	2.777	1.389	1.244	2.630	1.572	2.405	0.1341	0.0821	0.1267
42	0.1073	0.0508	0.0473	2.895	1.448	1.297	2.502	1.496	2.289	0.1298	0.0796	0.1228
41	0.1102	0.0522	0.0486	3.016	1.509	1.352	2.381	1.423	2.179	0.1258	0.0772	0.1191
40	0.1131	0.0537	0.0499	3.142	1.572	1.410	2.266	1.355	2.075	0.1220	0.0749	0.1155
39	0.1163	0.0553	0.0513	3.273	1.637	1.470	2.157	1.290	1.976	0.1183	0.0727	0.1121
38	0.1195	0.0569	0.0527	3.414	1.703	1.534	2.054	1.229	1.883	0.1148	0.0706	0.1089
37	0.1230	0.0586	0.0542	3.550	1.771	1.596	1.956	1.170	1.794	0.1114	0.0686	0.1058
36	0.1266	0.0604	0.0558	3.690	1.842	1.661	1.864	1.115	1.710	0.1082	0.0667	0.1029
35	0.1303	0.0623	0.0575	3.835	1.915	1.728	1.776	1.063	1.630	0.1052	0.0649	0.1001
34	0.1343	0.0643	0.0592	3.985	1.990	1.797	1.693	1.013	1.554	0.1023	0.0632	0.0974
33	0.1384	0.0664	0.0611	4.140	2.068	1.868	1.614	0.966	1.482	0.0995	0.0615	0.0948
32	0.1428	0.0686	0.0630	4.300	2.149	1.942	1.539	0.921	1.413	0.0969	0.0599	0.0924
31	0.1473	0.0709	0.0650	4.465	2.231	2.019	1.467	0.878	1.348	0.0943	0.0584	0.0901
30	0.1521	0.0733	0.0671	4.635	2.317	2.098	1.399	0.838	1.286	0.0919	0.0570	0.0878
29	0.1571	0.0758	0.0693	4.811	2.405	2.179	1.335	0.799	1.228	0.0896	0.0556	0.0857
28	0.1624	0.0784	0.0716	4.991	2.496	2.263	1.274	0.763	1.172	0.0874	0.0543	0.0837
27	0.1679	0.0812	0.0741	5.176	2.589	2.350	1.216	0.728	1.119	0.0853	0.0530	0.0818
26	0.1737	0.0841	0.0766	5.367	2.685	2.439	1.160	0.695	1.068	0.0833	0.0518	0.0799
25	0.1797	0.0871	0.0793	5.563	2.783	2.531	1.108	0.663	1.020	0.0814	0.0507	0.0781
24	0.1861	0.0903	0.0821	5.763	2.884	2.625	1.058	0.634	0.974	0.0795	0.0496	0.0764
23	0.1928	0.0936	0.0851	5.969	2.987	2.722	1.010	0.605	0.931	0.0778	0.0485	0.0748
22	0.1997	0.0971	0.0882	6.180	3.093	2.822	0.965	0.578	0.889	0.0761	0.0475	0.0733
21	0.2071	0.1008	0.0914	6.395	3.201	2.924	0.922	0.552	0.850	0.0745	0.0466	0.0718
20	0.2148	0.1046	0.0948	6.615	3.312	3.028	0.881	0.528	0.812	0.0730	0.0457	0.0704
19	0.2228	0.1087	0.0983	6.840	3.425	3.135	0.842	0.505	0.776	0.0715	0.0448	0.0691
18	0.2312	0.1129	0.1021	7.069	3.540	3.245	0.804	0.482	0.742	0.0701	0.0440	0.0678
17	0.2401	0.1173	0.1060	7.303	3.658	3.356	0.769	0.461	0.710	0.0688	0.0432	0.0666
16	0.2494	0.1220	0.1101	7.541	3.777	3.471	0.735	0.441	0.679	0.0675	0.0424	0.0654
15	0.2591	0.1269	0.1144	7.783	3.899	3.587	0.703	0.422	0.649	0.0663	0.0417	0.0643
14	0.2693	0.1320	0.1189	8.029	4.022	3.706	0.672	0.404	0.621	0.0652	0.0410	0.0633
13	0.2800	0.1373	0.1236	8.278	4.148	3.826	0.643	0.386	0.595	0.0641	0.0404	0.0622
12	0.2911	0.1429	0.1286	8.531	4.275	3.949	0.616	0.370	0.569	0.0630	0.0397	0.0613
11	0.3029	0.1488	0.1337	8.787	4.403	4.074	0.589	0.354	0.545	0.0620	0.0391	0.0603
10	0.3152	0.1550	0.1392	9.046	4.533	4.200	0.564	0.339	0.522	0.0611	0.0386	0.0595
9	0.3281	0.1614	0.1449	9.307	4.665	4.328	0.540	0.324	0.500	0.0602	0.0380	0.0586
8	0.3416	0.1682	0.1509	9.571	4.797	4.457	0.517	0.311	0.478	0.0593	0.0375	0.0578
7	0.3557	0.1753	0.1571	9.836	4.931	4.588	0.495	0.298	0.458	0.0584	0.0370	0.0570
6	0.3705	0.1827	0.1637	10.104	5.065	4.721	0.474	0.285	0.439	0.0576	0.0365	0.0563
5	0.3860	0.1905	0.1705	10.372	5.200	4.854	0.454	0.273	0.421	0.0569	0.0361	0.0556
4	0.4023	0.1986	0.1777	10.642	5.336	4.988	0.435	0.262	0.404	0.0562	0.0356	0.0549
3	0.4193	0.2072	0.1853	10.912	5.471	5.123	0.417	0.251	0.387	0.0555	0.0352	0.0543
2	0.4372	0.2161	0.1932	11.183	5.608	5.259	0.400	0.241	0.371	0.0548	0.0348	0.0537
1	0.4559	0.2255	0.2015	11.454	5.744	5.395	0.384	0.231	0.356	0.0542	0.0344	0.0531
BASE CONCENTRATION				11.725	5.880					0.0536	0.0341	

*ALL CONCENTRATIONS IN MOL % D2O.

NORMAL EXTRACTION TOWER CONCENTRATIONS*

TRAY	CT-1 X	CT-1 Y	CT-1 EQ-Y	HT-1 X	HT-1 Y	HT-1 EQ-X
FEED	0.01470					
70				0.05597	0.03407	0.05244
69	0.01447	0.00638		0.05347	0.03257	0.05013
68	0.01449	0.00639	0.00638	0.05110	0.03115	0.04795
67	0.01450	0.00640	0.00638	0.04886	0.02981	0.04588
66	0.01452	0.00640	0.00639	0.04674	0.02854	0.04392
65	0.01454	0.00641	0.00640	0.04474	0.02734	0.04208
64	0.01456	0.00642	0.00641	0.04285	0.02620	0.04033
63	0.01458	0.00644	0.00642	0.04106	0.02513	0.03868
62	0.01461	0.00645	0.00643	0.03937	0.02411	0.03711
61	0.01463	0.00646	0.00644	0.03777	0.02315	0.03564
60	0.01466	0.00647	0.00645	0.03626	0.02224	0.03424
59	0.01469	0.00649	0.00646	0.03482	0.02139	0.03292
58	0.01472	0.00651	0.00648	0.03347	0.02057	0.03167
57	0.01476	0.00652	0.00649	0.03219	0.01981	0.03049
56	0.01479	0.00654	0.00651	0.03098	0.01908	0.02937
55	0.01484	0.00656	0.00653	0.02984	0.01839	0.02832
54	0.01488	0.00659	0.00655	0.02876	0.01775	0.02732
53	0.01493	0.00661	0.00657	0.02773	0.01713	0.02637
52	0.01498	0.00664	0.00659	0.02677	0.01655	0.02548
51	0.01504	0.00667	0.00662	0.02585	0.01600	0.02463
50	0.01510	0.00670	0.00664	0.02499	0.01548	0.02383
49	0.01517	0.00673	0.00667	0.02417	0.01499	0.02308
48	0.01524	0.00677	0.00671	0.02340	0.01453	0.02237
47	0.01532	0.00681	0.00674	0.02266	0.01409	0.02169
46	0.01540	0.00685	0.00678	0.02197	0.01367	0.02105
45	0.01549	0.00690	0.00682	0.02132	0.01328	0.02045
44	0.01559	0.00695	0.00686	0.02070	0.01291	0.01988
43	0.01570	0.00700	0.00691	0.02011	0.01256	0.01934
42	0.01582	0.00706	0.00696	0.01956	0.01223	0.01882
41	0.01594	0.00712	0.00702	0.01904	0.01191	0.01834
40	0.01608	0.00719	0.00708	0.01854	0.01162	0.01788
39	0.01623	0.00727	0.00714	0.01808	0.01134	0.01745
38	0.01639	0.00735	0.00721	0.01763	0.01107	0.01704
37	0.01656	0.00744	0.00729	0.01721	0.01082	0.01666
36	0.01675	0.00753	0.00737	0.01682	0.01058	0.01629
35	0.01696	0.00764	0.00746	0.01644	0.01036	0.01595
34	0.01718	0.00775	0.00756	0.01609	0.01015	0.01562
33	0.01741	0.00787	0.00766	0.01576	0.00995	0.01531
32	0.01767	0.00800	0.00778	0.01544	0.00976	0.01502
31	0.01795	0.00814	0.00790	0.01514	0.00958	0.01474
30	0.01826	0.00829	0.00803	0.01486	0.00941	0.01448
29	0.01859	0.00846	0.00818	0.01459	0.00925	0.01423
28	0.01894	0.00864	0.00834	0.01434	0.00909	0.01400
27	0.01933	0.00884	0.00851	0.01410	0.00895	0.01378
26	0.01975	0.00905	0.00869	0.01387	0.00881	0.01357
25	0.02020	0.00928	0.00889	0.01366	0.00869	0.01337
24	0.02069	0.00952	0.00910	0.01345	0.00856	0.01318
23	0.02122	0.00979	0.00934	0.01326	0.00845	0.01301
22	0.02179	0.01008	0.00959	0.01308	0.00834	0.01284
21	0.02242	0.01040	0.00986	0.01291	0.00824	0.01268
20	0.02309	0.01074	0.01016	0.01275	0.00814	0.01253
19	0.02382	0.01111	0.01048	0.01260	0.00805	0.01239
18	0.02461	0.01151	0.01083	0.01245	0.00796	0.01226
17	0.02547	0.01194	0.01121	0.01231	0.00788	0.01213
16	0.02639	0.01241	0.01161	0.01218	0.00780	0.01201
15	0.02740	0.01292	0.01206	0.01206	0.00773	0.01190
14	0.02848	0.01347	0.01254	0.01195	0.00766	0.01179
13	0.02966	0.01406	0.01305	0.01184	0.00759	0.01169
12	0.03094	0.01471	0.01361	0.01173	0.00753	0.01159
11	0.03232	0.01541	0.01422	0.01163	0.00747	0.01150
10	0.03381	0.01616	0.01488			
9	0.03543	0.01698	0.01559			
8	0.03718	0.01787	0.01636			
7	0.03908	0.01883	0.01720			
6	0.04114	0.01987	0.01811			
5	0.04336	0.02099	0.01908			
4	0.04577	0.02221	0.02015			
3	0.04838	0.02353	0.02129			
2	0.05121	0.02496	0.02254			
1	0.05427	0.02651	0.02389			
BASE CONCENTRATION	0.05758	0.02819		0.01154	0.00742	

EXTRACTION OPERATING LINE INTERCEPTS

CT-1	HT-1	CT-2	HT-2	
0.18587D-04	-0.82144D-05	0.59414D-04	-0.34971D-04	← At tower top
0.18587D-04	-0.82144D-05	0.25056D-03	-0.34971D-04	← At tower base

* ALL CONCENTRATIONS IN MOL % D_2O

APPENDIX B

TEST PROBLEM CONDITIONS AND RESULTS

DW PLANT TOWER		EP-90	EP-70	EP-50	EP-30	EP-4	EP-7
HEAD PRESS.	MM HG	60.0	60.0	60.0	80.0	259.7	110.0
TOWER DP	MM HG	229.3	297.9	321.0	275.2	193.9	149.7
BASE PRES.	MM HG	289.3	357.9	381.0	355.2	453.6	259.7
VAPOR RATE	MOL/HR	170.0	230.0	250.0	410.0	880.0	880.0
EFFICIENCY, EMV		0.5746	0.4818	0.4493	0.5525	0.7056	0.7056
F-FACTOR AT TOP		1.2213	1.6523	1.7960	1.6453	0.6649	0.6391

DW FEED FROM EXTN	62.696 MOL/HR	0.1182 MOL FR D2O
DW RECYCLE FEED 1	0.LBS/DAY	0.0 MOL FR D2O
DW RECYCLE FEED 2	0.LBS/DAY	0.0 MOL FR D2O
DW RECYCLE FEED 3	0.LBS/DAY	0.0 MOL FR D2O

EXTRACTION AREA TOWER		CT-1	HT-1	CT-2	HT-2
NO. OF EXTRACTION UNITS		8.			
GAS FLOW PER UNIT	LB/HR	668000.		186000.	
TOWER TOP LIQUOR FEED	MOL/HR	74377.			
TOTAL EXIT GAS FLOW	MOL/HR	157176.	194234.	43765.	54185.
TOWER TOP LIQUOR RATE	MOL/HR	76462.	113517.	21984.	32402.
LIQUOR ADDED OR RECYCLED	MOL/HR		50000.	60.	0.
TRAY NUMBER			23	39	119
L/G AT TOWER TOP		0.4865	0.5844	0.5023	0.5980
L/G AT TOWER BASE		0.4865	0.8419	0.5037	0.5980
ESTIMATED STEAM INPUT	MOL/HR		13361.5		
STRIPPER OFF-GAS RATE	MOL/HR		14688.8		
STRIPPER OFF-GAS MOL % D2O			0.01231		
WASTE WATER RATE	MOL/HR		137735.		
WASTE WATER MOL % D2O			0.01275		
PRESSURE	PSIA	295.	320.	265.	300.
TEMPERATURE	DEGREES C	32.0	144.0	33.0	142.0
BETA		2.2726	1.5395	2.2685	1.5428
EMV OR EML		0.590	0.710	0.390	0.570
HUMIDITY	MOL H2O/MOL H2S	0.00351	0.24810	0.00393	0.24970
SOLUBILITY	MOL H2S/MOL H2O	0.02804	0.00964	0.02456	0.00911

PRODUCTION RATE	MOL D2O/HR	LB D2O/DAY
CALCULATION BASIS IN EXTN		
1ST STAGE OP LINES	0.26901D 01	0.12930D 04
2ND STAGE OP LINES	0.26901D 01	0.12930D 04
NET FWD FEED TO DW	0.26898D 01	0.12929D 04
TOTAL RCYL FED TO DW	0.0	0.0
TOTAL DW DRAWOFF RATE	0.26898D 01	0.12929D 04

TEST EXTRACTION TOWER CONCENTRATIONS*

	CT-2A			CT-2B			HT-2A			HT-2B		
TRAY	X	Y	EQ-Y	X	Y	EQ-Y	X	Y	EQ-X	X	Y	EQ-X
84				0.550	0.273							
83	0.0652	0.0293		0.574	0.285	0.254						
82	0.0656	0.0295	0.0289	0.600	0.298	0.265						
81	0.0661	0.0297	0.0291	0.626	0.311	0.277						
80	0.0666	0.0300	0.0294	0.654	0.325	0.289						
79	0.0671	0.0302	0.0296	0.683	0.340	0.302						
78	0.0676	0.0305	0.0298	0.713	0.355	0.316						
77	0.0682	0.0308	0.0301	0.745	0.371	0.330						
76	0.0688	0.0311	0.0303	0.779	0.388	0.345						
75	0.0694	0.0314	0.0306	0.813	0.405	0.360						
74	0.0700	0.0317	0.0309	0.850	0.423	0.376						
73	0.0707	0.0321	0.0312	0.888	0.443	0.393						
72	0.0714	0.0324	0.0315	0.928	0.463	0.411						
71	0.0722	0.0328	0.0318	0.970	0.484	0.430						
70	0.0730	0.0332	0.0322	1.014	0.506	0.449				0.4152	0.2504	0.3859
69	0.0738	0.0336	0.0326	1.059	0.529	0.470	12.669	7.578	11.229	0.3985	0.2405	0.3705
68	0.0747	0.0341	0.0329	1.107	0.553	0.491	11.848	7.085	10.526	0.3825	0.2309	0.3558
67	0.0756	0.0345	0.0333	1.157	0.578	0.513	11.095	6.635	9.880	0.3673	0.2218	0.3418
66	0.0766	0.0350	0.0338	1.210	0.604	0.537	10.402	6.221	9.284	0.3528	0.2131	0.3284
65	0.0776	0.0355	0.0342	1.264	0.632	0.561	9.765	5.839	8.732	0.3389	0.2048	0.3157
64	0.0786	0.0360	0.0347	1.321	0.660	0.587	9.176	5.487	8.221	0.3257	0.1969	0.3035
63	0.0798	0.0366	0.0352	1.381	0.690	0.613	8.632	5.162	7.746	0.3130	0.1893	0.2918
62	0.0809	0.0372	0.0357	1.443	0.721	0.641	8.127	4.860	7.305	0.3009	0.1821	0.2807
61	0.0821	0.0378	0.0362	1.508	0.754	0.670	7.659	4.580	6.894	0.2894	0.1742	0.2701
60	0.0834	0.0385	0.0368	1.576	0.788	0.701	7.223	4.319	6.511	0.2784	0.1687	0.2600
59	0.0848	0.0391	0.0374	1.646	0.824	0.733	6.817	4.077	6.153	0.2679	0.1624	0.2503
58	0.0862	0.0398	0.0380	1.720	0.861	0.766	6.439	3.850	5.819	0.2579	0.1564	0.2410
57	0.0877	0.0406	0.0387	1.797	0.899	0.800	6.085	3.639	5.506	0.2483	0.1506	0.2322
56	0.0893	0.0414	0.0394	1.877	0.940	0.836	5.755	3.441	5.212	0.2391	0.1452	0.2238
55	0.0909	0.0422	0.0401	1.961	0.982	0.874	5.445	3.256	4.937	0.2304	0.1399	0.2157
54	0.0926	0.0431	0.0409	2.048	1.025	0.913	5.155	3.083	4.678	0.2220	0.1349	0.2080
53	0.0944	0.0440	0.0416	2.138	1.071	0.954	4.883	2.920	4.435	0.2141	0.1302	0.2007
52	0.0963	0.0449	0.0425	2.233	1.118	0.997	4.628	2.767	4.206	0.2064	0.1256	0.1937
51	0.0983	0.0459	0.0434	2.331	1.167	1.041	4.388	2.624	3.991	0.1992	0.1213	0.1870
50	0.1004	0.0470	0.0443	2.433	1.219	1.087	4.162	2.489	3.788	0.1922	0.1171	0.1806
49	0.1026	0.0481	0.0453	2.539	1.272	1.135	3.949	2.361	3.597	0.1856	0.1132	0.1745
48	0.1049	0.0492	0.0463	2.649	1.327	1.185	3.748	2.241	3.416	0.1792	0.1094	0.1686
47	0.1073	0.0505	0.0473	2.763	1.385	1.237	3.559	2.131	3.249	0.1732	0.1057	0.1630
46	0.1099	0.0517	0.0485	2.882	1.444	1.291	3.383	2.025	3.090	0.1674	0.1023	0.1577
45	0.1125	0.0531	0.0496	3.006	1.506	1.348	3.216	1.925	2.940	0.1619	0.0990	0.1526
44	0.1153	0.0545	0.0509	3.133	1.571	1.406	3.058	1.831	2.797	0.1566	0.0958	0.1478
43	0.1183	0.0560	0.0522	3.266	1.637	1.466	2.909	1.742	2.662	0.1516	0.0928	0.1431
42	0.1214	0.0575	0.0535	3.403	1.706	1.529	2.769	1.658	2.535	0.1467	0.0899	0.1387
41	0.1246	0.0591	0.0550	3.545	1.777	1.594	2.635	1.578	2.414	0.1421	0.0872	0.1344
40	0.1280	0.0608	0.0565	3.692	1.851	1.662	2.509	1.503	2.300	0.1377	0.0845	0.1304
39	0.1316	0.0626	0.0580	3.844	1.928	1.732	2.390	1.431	2.191	0.1335	0.0820	0.1265
38	0.1353	0.0645	0.0597	4.008	2.005	1.807	2.276	1.363	2.088	0.1295	0.0796	0.1228
37	0.1392	0.0665	0.0614	4.166	2.084	1.880	2.169	1.299	1.991	0.1257	0.0773	0.1193
36	0.1434	0.0686	0.0633	4.329	2.166	1.956	2.067	1.238	1.898	0.1220	0.0751	0.1159
35	0.1477	0.0707	0.0652	4.497	2.251	2.034	1.971	1.181	1.810	0.1185	0.0731	0.1127
34	0.1522	0.0730	0.0672	4.671	2.339	2.114	1.879	1.126	1.726	0.1152	0.0711	0.1096
33	0.1570	0.0754	0.0693	4.850	2.429	2.198	1.792	1.074	1.647	0.1120	0.0691	0.1066
32	0.1620	0.0779	0.0715	5.034	2.522	2.284	1.709	1.024	1.572	0.1089	0.0673	0.1038
31	0.1673	0.0806	0.0738	5.224	2.617	2.372	1.631	0.977	1.500	0.1060	0.0656	0.1011
30	0.1728	0.0833	0.0762	5.419	2.716	2.464	1.556	0.933	1.432	0.1032	0.0639	0.0986
29	0.1786	0.0862	0.0788	5.620	2.816	2.558	1.485	0.890	1.367	0.1006	0.0623	0.0961
28	0.1846	0.0893	0.0815	5.825	2.920	2.654	1.418	0.850	1.306	0.0980	0.0608	0.0938
27	0.1910	0.0925	0.0843	6.036	3.026	2.754	1.354	0.812	1.247	0.0956	0.0593	0.0915
26	0.1977	0.0958	0.0872	6.253	3.135	2.856	1.293	0.775	1.191	0.0933	0.0579	0.0894
25	0.2047	0.0994	0.0903	6.474	3.247	2.961	1.235	0.741	1.138	0.0910	0.0566	0.0873
24	0.2120	0.1031	0.0936	6.700	3.361	3.068	1.180	0.708	1.088	0.0889	0.0553	0.0854
23	0.2198	0.1069	0.0970	6.931	3.477	3.179	1.127	0.676	1.040	0.0869	0.0541	0.0835
22	0.2279	0.1110	0.1006	7.167	3.596	3.291	1.077	0.646	0.994	0.0850	0.0530	0.0817
21	0.2364	0.1153	0.1043	7.408	3.717	3.406	1.030	0.618	0.950	0.0831	0.0519	0.0800
20	0.2453	0.1198	0.1083	7.652	3.840	3.524	0.984	0.591	0.909	0.0813	0.0508	0.0784
19	0.2546	0.1245	0.1124	7.902	3.966	3.644	0.941	0.565	0.869	0.0796	0.0498	0.0768
18	0.2644	0.1294	0.1167	8.155	4.093	3.766	0.900	0.540	0.831	0.0780	0.0488	0.0753
17	0.2747	0.1346	0.1213	8.412	4.223	3.891	0.861	0.517	0.795	0.0765	0.0479	0.0739
16	0.2855	0.1400	0.1261	8.672	4.354	4.018	0.823	0.495	0.761	0.0750	0.0470	0.0725
15	0.2969	0.1457	0.1311	8.936	4.487	4.146	0.788	0.473	0.728	0.0736	0.0462	0.0712
14	0.3087	0.1516	0.1363	9.203	4.621	4.277	0.754	0.453	0.697	0.0723	0.0454	0.0700
13	0.3212	0.1579	0.1418	9.472	4.757	4.409	0.722	0.434	0.668	0.0710	0.0446	0.0688
12	0.3343	0.1644	0.1476	9.744	4.894	4.543	0.691	0.415	0.639	0.0697	0.0439	0.0677
11	0.3480	0.1713	0.1537	10.018	5.032	4.678	0.661	0.398	0.612	0.0686	0.0432	0.0666
10	0.3623	0.1785	0.1600	10.294	5.171	4.815	0.633	0.381	0.586	0.0674	0.0425	0.0656
9	0.3774	0.1861	0.1667	10.571	5.310	4.952	0.607	0.365	0.562	0.0664	0.0419	0.0646
8	0.3932	0.1941	0.1737	10.849	5.451	5.091	0.581	0.350	0.538	0.0653	0.0412	0.0636
7	0.4097	0.2024	0.1810	11.128	5.591	5.231	0.557	0.335	0.516	0.0644	0.0407	0.0627
6	0.4271	0.2111	0.1887	11.407	5.732	5.371	0.534	0.321	0.495	0.0634	0.0401	0.0618
5	0.4453	0.2202	0.1968	11.686	5.872	5.512	0.512	0.308	0.474	0.0625	0.0396	0.0610
4	0.4644	0.2298	0.2052	11.965	6.013	5.653	0.490	0.295	0.455	0.0617	0.0391	0.0602
3	0.4844	0.2399	0.2141	12.243	6.153	5.794	0.470	0.283	0.437	0.0609	0.0386	0.0595
2	0.5054	0.2504	0.2234	12.520	6.292	5.935	0.451	0.272	0.419	0.0601	0.0381	0.0588
1	0.5273	0.2614	0.2331	12.796	6.431	6.075	0.433	0.261	0.402	0.0593	0.0376	0.0581
BASE CONCENTRATION				13.070	6.569					0.0586	0.0372	

*ALL CONCENTRATIONS IN MOL % D2O.

TEST EXTRACTION TOWER CONCENTRATIONS*

TRAY	CT-1 X	CT-1 Y	CT-1 EQ-Y	HT-1 X	HT-1 Y	HT-1 EQ-X
FEED	0.01470					
BASE						
70				0.06222	0.03724	0.05732
69	0.01447	0.00641		0.05874	0.03521	0.05419
68	0.01453	0.00644	0.00639	0.05551	0.03332	0.05128
67	0.01459	0.00647	0.00642	0.05251	0.03157	0.04859
66	0.01465	0.00650	0.00645	0.04972	0.02994	0.04608
65	0.01472	0.00653	0.00648	0.04714	0.02843	0.04375
64	0.01479	0.00657	0.00651	0.04474	0.02702	0.04159
63	0.01487	0.00661	0.00654	0.04251	0.02472	0.03959
62	0.01495	0.00665	0.00658	0.04043	0.02451	0.03773
61	0.01504	0.00669	0.00662	0.03851	0.02338	0.03600
60	0.01513	0.00673	0.00666	0.03672	0.02234	0.03439
59	0.01522	0.00678	0.00670	0.03507	0.02137	0.03290
58	0.01532	0.00683	0.00674	0.03353	0.02047	0.03151
57	0.01543	0.00688	0.00679	0.03209	0.01963	0.03022
56	0.01554	0.00693	0.00684	0.03077	0.01886	0.02903
55	0.01566	0.00699	0.00689	0.02953	0.01814	0.02792
54	0.01579	0.00705	0.00695	0.02839	0.01747	0.02689
53	0.01593	0.00712	0.00701	0.02732	0.01685	0.02593
52	0.01607	0.00719	0.00707	0.02633	0.01627	0.02504
51	0.01622	0.00726	0.00714	0.02542	0.01573	0.02422
50	0.01638	0.00734	0.00721	0.02456	0.01523	0.02345
49	0.01655	0.00743	0.00729	0.02377	0.01477	0.02274
48	0.01674	0.00751	0.00736	0.02304	0.01434	0.02208
47	0.01693	0.00761	0.00745	0.02236	0.01394	0.02146
46	0.01713	0.00771	0.00754	0.02172	0.01357	0.02089
45	0.01735	0.00781	0.00763	0.02113	0.01323	0.02036
44	0.01757	0.00792	0.00773	0.02059	0.01291	0.01987
43	0.01781	0.00804	0.00784	0.02008	0.01261	0.01941
42	0.01807	0.00816	0.00795	0.01961	0.01234	0.01899
41	0.01834	0.00830	0.00807	0.01917	0.01208	0.01860
40	0.01863	0.00843	0.00820	0.01876	0.01184	0.01823
39	0.01893	0.00858	0.00833	0.01838	0.01162	0.01789
38	0.01926	0.00874	0.00847	0.01803	0.01142	0.01757
37	0.01960	0.00891	0.00862	0.01771	0.01123	0.01728
36	0.01996	0.00908	0.00878	0.01740	0.01105	0.01701
35	0.02034	0.00927	0.00895	0.01712	0.01088	0.01676
34	0.02075	0.00947	0.00913	0.01686	0.01073	0.01652
33	0.02118	0.00968	0.00932	0.01662	0.01059	0.01630
32	0.02164	0.00990	0.00952	0.01639	0.01046	0.01610
31	0.02212	0.01013	0.00973	0.01619	0.01034	0.01591
30	0.02263	0.01038	0.00996	0.01599	0.01022	0.01574
29	0.02318	0.01065	0.01020	0.01581	0.01012	0.01557
28	0.02375	0.01093	0.01045	0.01564	0.01002	0.01542
27	0.02436	0.01122	0.01072	0.01549	0.00993	0.01528
26	0.02501	0.01154	0.01101	0.01534	0.00984	0.01515
25	0.02569	0.01187	0.01131	0.01521	0.00977	0.01503
24	0.02642	0.01222	0.01163	0.01508	0.00969	0.01492
23	0.02718	0.01260	0.01196	0.01497	0.00963	0.01482
22	0.02800	0.01299	0.01232	0.01480	0.00956	0.01472
21	0.02886	0.01341	0.01270	0.01474	0.00952	0.01465
20	0.02977	0.01386	0.01310	0.01468	0.00946	0.01457
19	0.03074	0.01433	0.01353	0.01460	0.00939	0.01446
18	0.03177	0.01483	0.01398	0.01450	0.00931	0.01434
17	0.03286	0.01536	0.01446	0.01439	0.00922	0.01419
16	0.03401	0.01592	0.01497	0.01425	0.00910	0.01401
15	0.03523	0.01651	0.01550	0.01408	0.00896	0.01379
14	0.03652	0.01714	0.01607	0.01387	0.00878	0.01352
13	0.03789	0.01780	0.01667	0.01362	0.00857	0.01320
12	0.03934	0.01851	0.01731	0.01332	0.00832	0.01281
11	0.04088	0.01926	0.01799	0.01295	0.00801	0.01233
10	0.04250	0.02005	0.01871			
9	0.04423	0.02089	0.01947			
8	0.04606	0.02178	0.02027			
7	0.04799	0.02272	0.02112			
6	0.05004	0.02372	0.02203			
5	0.05221	0.02477	0.02298			
4	0.05452	0.02589	0.02400			
3	0.05695	0.02708	0.02507			
2	0.05954	0.92834	0.02621			
1	0.06227	0.02967	0.02741			
BASE CONCENTRATION	0.06517	0.03108		0.01251	0.00764	

*EXTRACTION OPERATING LINE INTERCEPTS

CT-1	HT-1	CT-2	HT-2	
0.12903D-04	-0.15007D-04	0.68809D-04	-0.36335D-04	← At tower top
0.12903D-04	0.34430D-04	0.28263D-03	-0.36335D-04	← At tower base

*ALL CONCENTRATIONS IN MOL % D2O