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EFFECT OF COLUMN DIAMETER ON

THE FREQUENCY RESPONSE OF

WATER FLUIDIZED BEDS

ΒY

EDWARD C. MAIURO

A THESIS

PRESENTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE

OF

MASTER OF SCIENCE IN CHEMICAL ENGINEERING

ΑT

NEWARK COLLEGE OF ENGINEERING

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> Newark, New Jersey 1968

APPROVAL OF THESIS

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ABSTRACT

The effect of column diameter on the frequency response of water fluidized beds was investigated.

Studies were made on four columns ranging from four to ten inches in diameter. Water was used to fluidize the beds which consisted of spherical glass beads .0185 inches in diameter. A trace solution of sodium chloride was sinusoidally introduced into the beds. Inlet and outlet concentrations were continuously measured by an electrical conductivity recorder. Separate frequency response tests were conducted on the inlet calmning section in an attempt to obtain the frequency response of this region alone. Results of the tests were expressed as Bode plots.

As the bed diameter was increased, the system became more backmixed in nature. In an attempt to quantify this data, theoretical frequency response curves were calculated based on the mixing cell model. However, over the range of frequencies tested, poor correlation was obtained between this theoretical model and the empirical data.

ACKNOWLEDGMENTS

The author wishes to express his indebtedness to Dr. Deran Hanesian for his guidance during the course of this study; and to his wife, Agnes Maiuro, for her encouragement and patient endurance, as well as her aid in typing the manuscript.

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INTRODUCTION

Scaling up results from small to large size fluidized beds is an important and difficult problem. It has been recognized that large units generally give results differing from small scale laboratory units. A basic problem facing the designer of a fluidized system is that the flow behavior of large beds differs substantially from small units.(1)

The purpose of this study was to investigate the effect of column diameter on the frequency response of the fluidized bed.

The dynamic characteristics of tubular flow systems, including fluidized systems, may be conveniently expressed in terms of frequency response data. The frequency response method yields results which are reproducible and relatively easy to compare with those obtained from theoretical models.

In frequency response testing a sine wave of a given amplitude and frequency is used as the input signal to the system being studied. The output signal should also be a sine wave with the same frequency; but the amplitude and angular displacement of the wave will be altered in accordance with the dynamics of the system. The ratio of the output wave amplitude to the input wave amplitude, coupled with the angular displacement between the two waves constitute the data of frequency response.

-1-

In reality, the flow in a fluidized bed, as well as most other physical processes, is extremely complex and non-linear in nature. However, a system will respond linearly for a given amplitude and range of frequencies. A linear system is one that may be described by linear differential equations. In frequency response terms, a system is linear if the frequency of the output wave equals the frequency of the input wave. Therefore, to employ the frequency response technique readily, it is imperative to remain within the linear bounds of the system.

The purpose of this study was to investigate the effect of bed diameter on the frequency response of fluidized beds, not to develop a rigorous fluid bed model. In an attempt to quantify the empirical data obtained, a rather simplified model was used, the mixing cell model. In this model, one attempts to account for the longitudinal mixing by assuming that the bed acts as a series of noninteracting perfect mixers.⁽²⁾ Theoretical frequency response curves were calculated based on the mixing cell flow model. These theoretical curves were then compared to the experimental curves to arrive at the number of perfect mixers for each column.

Much work has been performed on the dynamic analysis of fluid bed systems by step, pulse and frequency response techniques. However, an exhaustive search of the literature has revealed that the bulk of this work has been performed on small size columns, 4 inch diameter and less. There is a lack

`2

of data for a broad range of column diameters. It is for this reason that the 4 to 10 inch beds were evaluated.

A listing and summarization of previous work on longitudinal dispersion of liquid in fixed and fluidized beds is presented in AIChE Preprint 33E, November 26-30, 1967.

APPROACH TO THE PROBLEM

Theoretical responses were calculated for each column over the range of frequencies tested by use of the mixing cell model. A computer was employed in the calculation of the theoretical responses for N perfect mixing cells. Bode plot data was obtained for values of N ranging from 1 to 200.

A frequency response analysis was performed on each column and the results plotted on Bode diagrams. These experimental results were then compared to the theoretical frequency responses.

Each column consisted of two sections, the packed calmning section and the fluidized section. As it was the intent of this work to develop a scale-up correlation for fluidized beds, only the response of the fluidized section was desired. Therefore, the inlet conductivity cell was placed as close as possible to the base of the fluidized bed. (See Fig. 2) However, due to the construction of the cell, the signal measured was not the conductivity directly at the base of the fluidized bed. But rather, it was the conductivity 3-3/4 inches below the fluidbed base. It was therefore necessary to determine the response of this section alone. The response of the fluidized section could then be obtained by subtracting the packed calmning section response from the overall system response.

To obtain the response of the calmning section alone, one must run frequency response tests on each column with the fluidized section emptied. This was attempted. However, when the

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glass beads were removed from the columns, air bubbles formed on the conductivity electrodes. This resulted in completely meaningless conductivity readings and prevented experimental determination of the calmning section response. This difficulty necessitated a different approach to the problem. As experimental determination of the calmning section response was impossible, a theoretical response based on the mixing cell model was calculated for this region.

EXPERIMENTAL APPARATUS AND EQUIPMENT

The experimental equipment included a low frequency sine wave generator which applied a 3-15 psig. air signal to a Mason Neilon control valve. This control valve was placed in the tracer inlet line. The control valve's opening and closing varied the amount of salt solution feed into the fluidized bed, thus causing the electrical conductivity of the bed to rise and fall.

The apparatus used for the experimentation is shown in Figures 1 and 2. The range of column diameters studied required the construction of an apparatus which was adaptable to all four columns.

Two 14 inch square steel plates were drilled and tapped at the centers to afford an entrance and exit for the liquid. Also, each plate was covered with soft rubber. This rubber functioned as a gasket at the plate and column interfaces. Each column consisted of two sections, the 8 inch calmning section and the 4.5 foot fluidizing section. In assembling each column, the calmning section was set down on the plate and filled with Raching Rings. A gasket and bed support screen were then placed over this first section. Another gasket followed and next the fluidizing section was bolted and clamped

to the calmning section. The entire column was then clamped between the two steel plates. Dow Hi-Vac grease was applied between the gaskets, column and plates to insure a water-tight seal. The glass beads for the fluidizing section were added after the column was assembled, through the fitting in the top plate. To change columns with this system, only loosening the clamps and a replacement of the column was required. All four columns were made of Lucite with a wall thickness of 1/8 inch.

The apparatus was constructed so that one conductivity cell was placed within the calmning section, and measured the conductivity at the base of the fluidized bed. The second conductivity cell was lowered through the top plate and positioned at the upper edge of the fluidized bed. These two cells transmitted the signals to a Beckmann Honeywell two pen electrolytic conductivity indicator recorder. The recorder range was O-10,000 micromhos, with a linear O-10 scale.

A pneumatic recorder was positioned in parallel with the control valve as a check on the air signal being supplied to the valve by the sine wave generator.

A saturated solution of sodium chloride was used for the trace signal. The salt solution was stored in a 55 gallon polyethylene drum. This solution was delivered to the bed by means of a centrifugal pump which provided a nearly constant head of 22 psig.

The fluidizing water for the system was checked for variations in static pressure, only slight fluctuations were noted. The water was fed into the columns by a 3/4 inch pipe through a rotameter. The overflow was carried to the sewer by a one inch rubber hose. The rotameters used for the fluidizing liquid were two Fischer-Porter rotameters. These meters were rated at 2.7 and 8.8 gallons per minute at 100% flow. The meters were calibrated and found to be linear.

FIGURE 1 EXPERIMENTAL EQUIPMENT LAYOUT





Figure 2 COLUMN ASSEMBLY

THEORETICAL ANALYSIS

General Theory

In the mixing cell model the system is represented as a series of finite, perfectly mixed cells. By definition the concentration in a perfect mixer has a value at every point equal to the concentration at the outlet C_0 . For continuous flow through the mixer we have the material balance:

 $C_{1} = C_{0} + T dC_{0}$ \overline{dT}

where T is the average time of residence (volume of the mixer divided by the constant volumetric flow rate). If C_1 is varied sinusoidally, then the value of the signal at any place in the system is given by:

 $C = X e^{jwt}$

(2)

(1)

X is a complex number which can be represented by a radius vector in the complex plane, having a certain length (magnitude) and a phase angle with respect to the positive real axis. In the frequency response analysis, the relationship between two signals C and their vectors X is of interest. It can be expressed by the ratio of their respective magnitudes (amplitude ratio) and the difference between their respective phase angle (phase lag). If the concentrations for the two signals are recorded, the complex ratio between X_0 and X_1 is called the harmonic response

function of the entire system (transfer function). This function depends on the frequency w of the applied signal in a way which is characteristic of the system.

Substitution of equation 2 into equation 1 yields:

$$X_{i} = X_{o} + j w T X_{o}$$
 (3)

and for the transfer function of one perfect mixer

$$\frac{X_0}{X_1} = \frac{1}{1 + jwT}$$
(4)

The value of the amplitude ratio (AR) and phase angle (ϕ) are:

 $AR = (1 + w^2 T^2)^{-\frac{1}{2}}$

 ϕ = -arc tan (wT)

Applying the result of equation 4 to a system containing N perfect mixers in cascade having equal times of residence (T/N), the transfer function is:

$$G(s) = \begin{bmatrix} 1 \\ \frac{T}{N}s + 1 \end{bmatrix}^{N}$$
(5)

$$G(jw) = \begin{bmatrix} 1 \\ \frac{T}{N}jw + 1 \end{bmatrix} N$$

where

or

T = Time Constant (min.) =
$$V/q$$

V = Total volume of N mixers (ft³)
q = Flow rate (ft³/min.)
N = Number of perfect mixing cells

From the transfer function, the amplitude ratio and phase angle may be obtained.

$$G(jw) = \begin{bmatrix} 1 \\ \sqrt{1 + (wT/N)^2} \end{bmatrix}^N$$
(6)

$$G(jw) = -N \operatorname{arc} \operatorname{tan} (wT/N)$$
 (7)

where

G(jw) = amplitude ratio = AR $G(jw) = phase angle = \emptyset$ w = frequency (cycles/min)

When a sinusoidal disturbance is introduced into a flow system, the outgoing signal is smaller in amplitude and exhibits a phase lag with respect to the entering signal. In general, the amplitude ratio is ≤ 1 and the phase angle ≤ 0.3

Application of General Theory

The system studied consisted of two regions, the packed calmning section and the fluidized section, each with its own transfer function. The mixing cell model assumes that the response of each element is independent of conditions in the other elements. The elements are considered non-interacting and the total system transfer function is the product of the individual transfer functions.

$$G = G_1 \cdot G_2 \tag{8}$$

where

G = total system transfer function

 G_1 = packed calmning section transfer function

 G_2 = fluidized bed transfer function

Also,

 $AR = AR_1 + M_2$ $\emptyset = \emptyset_1 + \emptyset_2$

Amplitude ratios will be utilized throughout this discussion, to obtain the number of mixing cells in each section. Values for N can be obtained from the phase angle curves of Bode plots, since a system with N mixing cells exhibits a phase lag of

14.

 $N \pi/2$ as the frequency approaches ∞ . However as real systems exhibit dead time, which effects the phase angle but not the amplitude ratio, the experimental determination of N from phase angle diagrams was not attempted.

$$AR = AR_1 \cdot AR_2$$

$$\left[1 + \left(\frac{wT}{N}\right)^{2}\right]^{-N/2} = \left[1 + \left(\frac{wT_{1}}{N_{1}}\right)^{2}\right]^{-N_{1}/2} \cdot \left[1 + \left(\frac{wT_{2}}{N_{2}}\right)^{2}\right]^{-N_{2}/2}$$
(9)

where

- N = number of mixing cells in total system. This value is determined from the experimental frequency response curve of the total system.
- N₁ = number of mixing cells in section 1 (packed calmning section)

 N_2 = number of mixing cells in section 2 (fluidized bed)

= are known quantities.

N, N₂

= unknown quantities

but

$$N = N_1 + N_2$$

therefore

$$N_2 = N - N_1$$

(11)

(10)



Figure 3 BLOCK DIAGRAM OF SYSTEM

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Equations 9 and 10 comprise two equations in two unknowns which were solved for N_2 , the number of mixing cells in the fluidized region. The solution was performed by a trial and error technique on a computer. This calculation yielded the amplitude ratio of the fluidized bed and in turn the number of perfect mixing cells.

RESULTS AND DISCUSSION

The frequency response tests were conducted to obtain the total system amplitude ratio curve, from which by a comparison with the theoretical model N could be obtained.

These tests were run on each column over a range of frequencies ranging from 7.50 cycles/min to 0.12 cycles/min. The input signal to the bed was sinusoidal in shape, while the outlet wave was less sinusoidal, in appearance it was more triangular. This effect was more noticeable at the lower frequencies. Typical experimental frequency response tests are presented in Figures 4 and 5. The system responded linearly over the range of frequencies tested. Figures 7, 8, 9, 10 are amplitude ratio plots obtained from the experimental data superimposed over the theoretical amplitude ratio plot for the N value which best fit the experimental data. Figure 6 contains the experimental amplitude ratio curves for all four bed diameters, computed from curves similar to those in Figures 4 and 5. It can be seen from Figure 6 that for a given frequency as bed diameter increases the amplitude ratio decreases.

Ferfect plug flow is postulated for a system where no amplitude attenuation of the incoming sinusoidal occurs. A plug flow system can be thought of as consisting of an infinite number of infinitesmally small perfect mixing cells, which would result in



TYPICAL FREQUENCY RESPONSE TEST (HIGH FREQUENCY)

Figure 4



TYPICAL FREQUENCY RESPONSE TEST (LCW FREQUENCY)

Figure 5

an amplitude ratio equivalent to unity. For a given frequency as the amplitude ratio decreases, more attenuation of the input sinusoidal, the system becomes less plug flow in nature, i.e., exhibits more backmixing. Hence, the experimental data tabulated in Figure 6 indicates that an increase in bed diameter results in increased backmixing. Kramer and Alberda⁴ have demonstrated that the frequency response diagrams of real systems generally lie between those for one perfect mixer and for perfect plug flow. However, it is not at all necessary that the diagram for a real system coincides with one for a certain number of perfect mixers.

A theoretical model, the mixing cell model, was employed in an attempt to quantify the empirical data obtained. However, attempts to represent the mixing phenomena of the total system by the mixing cell model proved unfruitful. The model yielded amplitude ratio curves whose shapes did not agree with the plots of the experimental values. It is perhaps significant however, that the curves did approach each other at the highest test frequency, 7.5 cycles/min. It seems logical to test at still higher frequencies to see if this trend is continued. This was attempted. A sinusoidal input of 15 cycles/min was introduced into the system. However, the noise inherent in the system obscurred the outlet sine wave making a computation of the amplitude for this higher frequency impossible.

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FIGURE 6

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FIGURE 8

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Hence, the theoretical values of N which yielded the best fit to the experimental data were chosen for the number of mixing cells for the total system, fluidized section and packed calmning section.

It is felt that better correlation between model and experimental data could have been obtained, if the response of the empty column could be obtained. It appears that at the low flow velocity utilized, a correction to the amplitude is required for interaction with the bed support and column wall. As was mentioned previously, this was attempted. The low flows had to be maintained due to the fact that the small beads chosen, .0185 in. diameter, were easily driven from the column. At these low flows. air bubbles entering the system dissolved in the water would accumulate on the conductivity electrode. This was not too severe a problem when beads were in the column, as they would circulate through the cell and displace the air bubbles. But when attempts were made at running the column empty, to measure entrance, column wall and bed support responses, bubbles accumulated on the electrodes and made conductivity measurement impossible.

The interaction with the bed support and column wall undoubtedly contributed to the disagreement between empirical results and theoretical predictions.

The values of N for the total system are listed in tables 6-9 As the N values were extremely low, computation of meaningful N_1 and N_2 values was impractical.

CONCLUSIONS

For the flow rate employed in this study, as bed diameter increased the flow pattern in the bed became less plug flow in nature and exhibited increased backmixing.

The fluidized and packed bed systems used in this study were linear.

It is believed that the poor correlation between experimental data and the theoretical mixing cell model, is in part due to the interaction of the wall and bed support.

The theoretical model used did not accurately describe the mixing phenomena in the fluidized beds studied. It is obvious that a different model, perhaps more sophisticated than the mixing cell model is required to describe the system.

RECOMMENDATIONS

1--

This study may be performed using a considerably larger bead size. This will allow the use of higher flow rates, without the fear of displacing beads from the column. At higher flow rates air bubbles do not accumulate on the conductivity cells, which tend to introduce noise into the system. Also, the higher flows and the resulting lower noise level will allow testing at higher frequencies. At the higher flow rate it will also be possible to test the effect of the empty column response, the wall response and bed support response, without having air bubbles hindering the measurement.

·2--

A study similar to the one performed over a range of flow rates may be of value.

3---

Utilization of a different model perhaps the axial diffusion model in arriving at a scale-up factor for fluidized beds.

FOOTNOTES

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APPENDIX

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Experimental Data	36
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Computer Data for Determination of N2	60

INSTRUMENT LIST

- 1. Conductivity Cells, Type Cel-VH2OKFT and Cel-VH2OKFT-Y-15 Beckman Instruments
- 2. Ultra Low Frequency Sinusoidal Signal Generator, Model SG-101P, Procedyne Associates Inc., New Brunswick, New Jersey
- 3. Consotrol Controller, Mode 58, Foxboro Co., Foxboro, Massachusetts
- 4. Control Valve, Model #37-24681, Mason Neilon Inc., Norwood, Massachusetts
- 5. Electrolytic Conductivity Recorder, Model Y15302816-02-99 Beckman/Honeywell
- 6. Rotameters -- Three -- .68 gpm,, 2.7 gpm., 8.8 gpm., Fischer-Porter, Warminster, Fennsylvania





ROTAMETER CALIBRATION CURVES

TABLE 1

EXPERIMENTALLY DETERMINED OVERALL SYSTEM AMPLITUDE RATIO

3.75 INCH COLUMN

w (Cycles/min)	Amplitude Ratio (AR)
7.50	.24
3.75	• 38
1.88	.43
0.94	.69
0.47	. 86
0.23	.94
0.12	.96

TABLE 2

EXPERIMENTALLY DETERMINED OVERALL SYSTEM AMPLITUDE RATIO

5.75 INCH COLUMN

w (Cycles/min)	Amplitude Ratio (AR)
7.50	.19
3.75	.31
1.88	•35
0.94	.51
0.47	.76
0,23	.86
0.12	.92

TABLE 3

EXPERIMENTALLY DETERMINED CVERALL SYSTEM AMPLITUDE RATIO

7.75 INCH COLUMN

w (Cycles/min)	Amplitude Ratio (AR)
7.50	.15
3.75	.20
1.88	,26
0.94	. 46
0.47	.69
0.23	.82
0.12	.85

TABLE 4

EXPERIMENTALLY DETERMINED OVERALL SYSTEM AMPLITUDE RATIO

9.75 INCH COLUMN

w (Cycles/min)	Amplitude Ratio (AR)
7.50	.09
3.75	.12
1.88	.23
0.94	.40
0.47	.64
0.23	.76
0.12	.79

NUMERICAL COMPUTATIONS

Time Constant Calculation

Danckwerts⁵ has shown that if a volume V is fed with a flow rate q, regardless of the transfer function of the region, the average time of travel through the region is V/q. This is the time constant (T) for a mixing process.

The time constant of the overall system studied is equal to the sum of the time constants of two sections.

 $T = T_1 + T_2$ T = V/q

q = constant to each section.

Hence, in order to calculate the time constants for each section it is necessary to compute the void volume in each section.

Fluidized Section

 $v_2 = v_s \cdot (E_2) + v_E$

where

 V_2 = void volume of fluidized region V_8 = volume of static bed E_2 = calculated voidage factor (.44) V_E = expanded volume



Packed Section

 $V_1 = V_p(E_1)$ where

> V₁ = void volume of packed region V_p = volume of packed region E₁ = calculated voidage factor for packing section (.65)

The voidage factor (E) for the static bed was experimentally determined by filling a cylinder with a known volume of water. To this the beads were added up to a given volume. The total volume of beads and water was then read, from this data the voidage factor was easily calculated. In a similar fashion, the voidage factor (E_1) for the packed calmning section was obtained.

Minimum Fluidization Mass Velocity Calculation

The mass flow rate (G_{mf}) at minimum fluidization⁶ is given by:

$$G_{mf} = \frac{688 \ D_p^{1.82} \left(ff \left[fs - ff \right] \right)}{u^{.88}} \cdot 94$$

where

$$G_{mf} = \text{mass flow rate (lb/hr-ft}^{2})$$

$$D_{p} = \text{diameter of beads (in)}$$

$$f = \text{density of fluidizing medium (lb/ft}^{3})$$

$$s = \text{density of beads (lb/ft}^{3})$$

$$u = \text{viscosity of fluidizing medium (lb/hr-sec)}$$

$$G_{mf} = \frac{688 (.0185)^{1.8} [62.3 (155.7-62.3)]}{(1.3)^{.88}}$$

 $G_{mf} = 1,310 \ lb/hr-ft^2$

The four columns were operated at approximately three times (2.96)this value. The study was limited to low flows because beads were driven out of the smaller columns at flows higher than three times the minimum fluidization velocity.

TA:	BL	Ε	5

			f		
Columns	Inside Diameter In	3. 75"	5.75"	7.75"	9.75 ⁿ
V	ft ³	.0404	.1097	.2300	.4235
Vl	ft ³	.0155	.0366	.0664	.1050
V ₂	ft3	.0249	.0731	.1636	.3189
q	ft ³ /min	.09	.20	.36	.57
T	min	.45	.54	.64	.75
T1	min	.17	.18	.19	.19
T ₂	min	.28	.36	.45	.56
Height of Static Bed	in	4 ¹¹	6"	811	10"
Height of Fluidized Bed (Section 2)	in	6"	8.25"	10.5"	11"
Height of Packed Bed (Section 1)	in	3.75"	3.75"	3.75"	3.75"

]	PROGRAM	A STATEMENT FOR DETERMIN	ATION OF N	42
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6		XXI#1000, PRINT 102		
10		IWT#O		
11	5	DD 20 I#I1,12,13		
13		×I#I		· · · · · · · · · · · · · · · · · · ·
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37	20	CONTINUE		
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57	30	XXI#XXI/10.		
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62		12#25	•	
64		XXI#1.		
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00145	105	212
00154	155	
00226	2005	254
00160	205	
00202	255	252
00211	305	242
00215	355	247
00016	55	261,265,274
00401	Α	188,189,191,203
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VIRTUAL	FILIO.	126,205,218
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00/11	IT	152
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00377	WIX	
00403	XI	144,145,147,157,172,177,186,195
00402	XXI	122,146,238,262,264,273
00232	0.0000	140,143,159,160,101,163,167,168,170,171,173,184,185
00140	P.0026	211
001/1	P+0042	240,241
00175	P.0045	246
00201	P.0050	251

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PHASE	E ANGLE	CALCUL	ATIONS, ED	М	IBLDR -	JOB	PHANG
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SYSTEM, I	NCLUDING	IOCS			00000	THRU	12273
FILE BLOCK	K ORIGIN				12302		
NUMBI	ER OF FI	LES =.	1				
1.	S.FBOU		· · · · · · · · · · · · · · · · · · ·	12302			
			ya af taya punchu, purtu nyar sing na na ana ana a s		10005	тири	14620
			·	4 - 205	12325		10020
1,	DECK OPH	ANGLE	*	12325			
5.	SUBR OUU	SYFBO		00000			
3.	SUBR @Pn	SIX @		12740	after of a party space way presson "Mar year's stranger that " A feature		
4	SUBR CON	SINIC	*	13053	•		
<u> </u>	SUBR OFP	K 0		13063	·		
6 ,	2088 GTÜ	5 (9 5 6		13004			
	SUDR CKW			13341			
8,	SUBR OFC	V (e)		14021			
9.	SUBR CHC	V @	s 1997 - 1999 - Maria Maria, ang	14113			
10.	SUBR EXC	V (@		14210			
11.	SUBR @IN			14237			
12	SUDK CFF	し (* す	W .	14333			
13.	SUDK CrP	N 0		15102			
14.	SUDH CXE	M (C	*	10032			
15.	SUBR GXI	<u>b</u> 1		15/45	n marchier san arange a seu arma ar 183 diade e a after ains	· Theorem 1999	
10,	SUBE SX-	5 . M		15745			
40	SUDR CAP			10010			
10,	SUDR CAT			10124			
<u> </u>	SUDK CLN	<u>u</u> (*	· _ · ·	14521			
%* = IN	VSERTION	SORD	ELETIONS M	ADE IN THIS D	ECKC	ny (-n.) ()	
INPUT - OU	JTPUT BU	FFERS	- <u></u>		77317	THRU	77776
UNUSED CON	RE	······································	·		16621	THRU	77313
					-		
			8 Jan 1 - Marine Jahang Angelan (1994) Angelan (1994) Angelan (1994) Angelan (1994)				
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						÷	

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NO. REACTORS	CYCLES/MIN.	TIME%MIN.C	GAIN
AD 62 00 40 44 59 50 70 90 90 90 90 90	المعادمة والإيراد المعاد مورد ولايا معاد المعاد		
1.0000	15.0000	0.4500	0.1465
1.0000	15.0000	0.5400	0,1225
1.0000	15.0000	0.6400	0.1036
1.0000	15,0000	0.7500	0.0885
1.0000	7.5000	0.4500	0.2841
1.0000	7.5000	0.5400	0,2397
1.0000	7.5000	0.6400	0.2040
1.0000	7.5000	0.7500	0,1750
1.0000	3.7500	0.4500	0.5098
1.0000	3,7500	0.5400	0.4428
1.0000	3.7500	0,6400	0.3846
1.0000	3.7500	0.7500	0,3350
1.0000	1.8750	0,4500	0.7643
1.0000	1.8750	0.5400	0.7027
1.0000	1.8750	0.6400	0.6402
1.0000	1,8750	0.7500	0,5795
1.0000	0,9375	0,4500	0,9214
1.0000	0,9375	0.5400	0,8922
1.0000	0.9375	0.6400	0,8575
1.0000	0,9375	0,7500	0,8180
1.0000	0,4688	0,4500	0,9785
1.0000	0,4688	0,5400	0,9694
1.0000	0.4688	0.6400	0,9578
1.0000	0.4688	0,7500	0,9434
1.0000	0 * 2344	0,4500	0,9945
1.0000	0,2344	0,5400	0,9921
1.0000	0,2344	0,6400	0,9889
1.0000	0.2344	0,7500	0,9849
1.0000	0.1172	0,4500	0,9986
1.0000.	0.1172	0,5400	0,9980
1.0000	0.1172	0,6400	0,9972
1.0000	0.1172	0.7500	0,9962
1.0000	0.0586	0,4500	0,9997
1.0000	0.0586	0,5400	0.9995
1.0000	0.0586	0,6400 -	0,9993
1.0000	0,0586	0,7500	0,9990
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	an un des minimum anno de provinsi deconstruction e , e desen an orderes and an orderes de la que a sera	na ama da da ante da comunicación de la desta de esta de esta de la desta de comunicación en esta de la defens E	na na sana ana ana ana ana ana ana ana a
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			narna - 11 me ann an pagas, 1/2 me a naraga <u>an marrier shàra</u> Baray ya shirida de anti
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NO. REACIORS	CYCLES/MIN.	TIME%MIN.C	GAIN
2.0000	15,0000	0,4500	0,080
. 2.0000	15,0000	0,5400	0,057
2,0000	15.0000	0,6400	0.041
2.0000	15,0000	0,7500	0.030
2.0000	7,5000	0.4500	0,259
2.0000	7,5000	0,5400	0,196
2.0000	7,5000	0.6400	0,147
2.0000	7.5000	0,7500	0.112
2.0000	3,7500	0,4500	0,58
2,0000	3.7500	0,5400	0,49
2.0000	3,7500	0,6400	0,40
2.0000	3,7500	0,7500	0,33
2,0000	1.8750	0.4500	0.848
2.0000	1.8750	0,5400	0.79
2.0000	1,8750	0.6400	0.73
2,0000	1,8750	0,7500	0.66
2.0000	0,9375	0.4500	0.95
2.0000	0.9375	0,5400	0,93
2.0000	0,9375	0.6400	0.91
2.0000	0,9375	0,7500	0,89
2,0000	0,4688	0.4500	0.98
2.0000	0,4688	0.5400	0,98
2.0000	0,4688	0.6400	0.97
2.0000	0,4688	0.7500	0,97
2,0000	0,2344	0,4500	0,99
2.0000	0.2344	0.5400	0.990
2,0000	0,2344	0.6400	0,99
2,0000	0.2344	0,7500	0.992
2.0000	0,1172	0.4500	0,990
2.0000	0.1172	0,5400	0.999
2.0000	0,1172	0,6400	0,99
2.0000	0,1172	0,7500	0,998
2.0000	0,0586	0.4500	0,999
2,0000	0.0586	0,5400	0,999
2.0000	0,0586	0.6400	0.999
2.0000	0,0586	0,7500	0,999
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	יי בארווייט איז	nen a presida a destructura consecutação destructura de consecutar a de de la consecutar e esta de se	nen a l'alemente entre anteres en contra de la conservativa en e
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	Mantan ar can arread ar a chair anns anns anns anns anns anns anns ann		-
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	waandama waa adaa umay ka maalada ga way uu waxaada ka uu ka aa	1999 - Sanada Sanad S	

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	NO. REACTORS	CYCLES/MIN.	TIME%MIN.C	GAIN
	Han mat han ann ann ann ann ann ann ann ann ann	402 (32 346 417 143 (36 359 77 166 687 146)	inter and day (and and the last day and the	
	3,0000	15,0000	0,4500	0,0670
	3,0000	15,0000	0,5400	0.0419
	3.0000	15.0000	0.6400	0,0265
	3.0000	15.0000	0.7500	0,01/1
	3,0000	7.5000	0.4500	0,2932
	3.0000	7.5000	0.5400	0,2109
	3.0000	7.5000	0.6400	0.1409
	3.0000	3 7500	0.4500	0,1042
	3,0000	3,7500	0.5400	0,0021
ar minin tanan kanan kara yang kang kanan ka	3.0000	3,7500	0.6400	0.4761
	3.0000	3,7500	0.7500	0.3883
	3.0000	1.8750	0,4500	0.8921
	3.0000	1.8750	0.5400	0.8506
	3.0000	1.8750	0.6400	0.8004
	3.0000	1.8750	0.7500	0.7423
an a	3.0000	0,9375	0.4500	0.9711
	3.0000	0,9375	0,5400	0,9588
	3.0000	0,9375	0,6400	0,9429
	3,0000	0.9375	0.7500	0,9229
	3.0000	0.4688	0.4500	0,9926
And according to prove the state providence where a second	3.0000	0.4688	0.5400	0,9894
	3,0000	0.4688	0.6400	0,9852
	3.0000	0.4688	0.7500	0,9797
	3.0000	0.2344	0.4500	0.9981
	. 3.0000	0.2344	0,5400	0,9973
	3.0000	$0_{*} < 344$	0.0400	0,9903
	3.0000	01173	0,7500	0,9949
	3.0000	0-1172	0.5400	0.9993
	3.0000	0.1172	0.6400	0,9991
	3.0000	0.1172	0.7500	0.9987
	3.0000	0.0586	0.4500	0.9999
	3.0000	0.0586	0.5400	0,9998
	3.0000	0.0586	0.6400	0,9998
	3.0000	0.0586	0.7500	0,9997
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	ana anananana a katalan na mananana katalan da katalan ang a mana ang ang ang ang ang ang ang ang ang	in an	an a phungan ang ang ang ang ang ang ang ang ang	
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NO. REACTORS	CYCLES/MIN.	TIME%MIN.C	GAIN
4 0000	15 0000	0 4500	0.0675
.4.0000	15,0000	0,4500	0,0075
4,0080	15,0000	0.5400	0,0384
4.0000	15.0000	0.8400	0,0219
4.0000	15,0000	0./200	0.0120
4.0000	7.5000	0.4500	0,3412
4.0000	7,5000	0.5400	0,2438
4,0000	7,5000	0.8400	0,1000
4.0000	2 7500	0.7500	0,1120
4.0000	2 7500	0.4500	0,7207
4.0000	3,7500	0.5400	0,0330
4.0000	3,7500	0.8400	0,5407
4.0000	3,7500	0.7500	0.4478
× 4.0000	1.0750	0,4500	0.9100
4.0000	1.8750	0,5400	0,8832
4.0000	1.8750	0.6400	0,8417
4.0000	1.8750	0.7500	0.7921
4.0000	0,93/5	0.4500	. 0,9781
4.0000	.0,9375	0.5400	0,9687
4.0000	0,9375	0,6400	0,9565
4.0000	0.9375	0,7500	0,9410
4.0000	0,4688	0,4500	0,9945
4.0000	0,4688	0,5400	0,9920
4.0000	0.4688	0.6400	0,9888
4.0000	0,4688	0.7500	0,9847
- 4.0000	0,2344	0.4500	0,9986
4.0000	0.2344	0,5400	0,9980
4.0000	0,2344	0.6400	0,9972
4.0000	0.2344	0,7500	0,9961
4.0000	0.1172	0.4500	0,9997
4.0000	0,1172	0.5400	0,9995
4.0000	0.1172	0.6400	0,9993
4.0000	0,1172	0,7500	0,9990
4.0000	0,0586	0,4500	0,9999
4,0000	0,0586	0,5400	0.9999
4.0000	0,0586	0.6400	0,9998
4.0000	0.0586	0,7500	0,9998
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NO. REACTORS CYCLES 5.0000 15 5.0000 15 5.0000 15 5.0000 15 5.0000 15 5.0000 7 5.0000 7 5.0000 7 5.0000 7 5.0000 7 5.0000 7 5.0000 7 5.0000 3 5.0000 3 5.0000 3 5.0000 1 5.0000 1 5.0000 1 5.0000 1 5.0000 1 5.0000 1 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000	0000 0000 0000 5000 5000 5000 5000 500	TIME%MIN 0.45 0.54 0.64 0.75 0.45 0.54 0.64	• [• • • • • • • • • • • • • • • • • •	GAIN 0.074 0.040 0.021 0.011
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0000 0000 0000 5000 5000 5000 5000 500	0,45 0,54 0,64 0,75 0,45 0,54 0,64	00 00 00 00 00	0,074 0,040 0,021 0,011
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0000 0000 0000 5000 5000 5000 5000 7500 7500	0,45 0,54 0,64 0,75 0,45 0,54 0,64	00 00 00 00 00	0,074 0,040 0,021 0,011
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0000 0000 5000 5000 5000 5000 7500 7500	0,54 0,64 0,75 0,45 0,54 0,64	00 00 00 00	0.040 0.021 0.011
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0000 0000 5000 5000 5000 5000 5000 7500 7500	0.64 0.75 0.45 0.54 0.64	00 00 00	0,021 0,011
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0000 5000 5000 5000 5000 7500 7500	0,75 0,45 0,54 0,64	00	0,011
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	5000 5000 5000 5000 7500 7500	0.45 0.54 0.64	00	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	5000 5000 5000 7500 7500	0,54		0.391
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	5000 5000 7500 7500	0.64	00	0.283
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	5000 7500 7500		.00	0.19
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	7500	0.75	00	0.129
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	7500	0.45	00	0.763
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		0.54	00	0.684
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$.7500	0.64	00	0,00-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$,7500	0,04	00	0,57-
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	8750	0,15	00	0.030
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	8750	0,40	00	0,952
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	9750	0,54	00	0.90-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	10/50	0,04	00	0.805
5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0	.8750	<u> </u>	00	0,820
5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0	9375	0,45	00	0,982
5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0	9375	0,54	00	0,974
5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0	,9375	0.64	.00	0,964
5.0000 0 5.0000 0 5.0000 0 5.0000 0 5.0000 0	,9375	.0.75	00	0,952
5.0000 0 5.0000 0 5.0000 0 5.0000 0	4688	0.45	00	0,995
5.0000 0 5.0000 0	.4688	0.54	,00	0,99:
5.0000 0	4688	0,64	.00	0,991
5,0000 0.	.4688	0,75	00	0,98
3.0000	,2344	0,45	00	0,998
5.0000 0	2344	0.54	00	0,998
5,0000 0	.2344	0.64	00	0,997
5.0000 0	.2344	0,75	00	0.996
5.0000 0	.1172	0.45	00	0.999
5.0000 . 0	,1172	0,54	00	0,999
5,0000 0	,1172	0.64	00	0,999
5.0000 0	.1172	0.75	00	0.999
5.0000 0	.0586	0.45	00	0.999
5.0000 0	.0586	0.54	00	0.999
5.0000 0	.0586	0.64	00 -	0.99
5.0000 0	.0586	0.75	00	0.999
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0,4500 0,5400 0,5400 0,6400 0,7500 0,4500 0,540000000000	GAIN 0.0860 0.044 0.022 0.0109 0.4384 0.3247 0.2267 0.1508 0.7958 0.7958 0.7958 0.7958 0.7958 0.7958 0.7958 0.9429 0.8890 0.8890 0.8518 0.9853 0.9706 0.9706 0.9947
$\begin{array}{c} 0,4500\\ 0,5400\\ 0,5400\\ 0,7500\\ 0,4500\\ 0,5400\\ 0,560\\ 0,$	0.086 0.044 0.022 0.010 0.438 0.324 0.226 0.150 0.7958 0.7958 0.7958 0.7958 0.723 0.6407 0.5511 0.9429 0.9429 0.9455 0.98518 0.9855 0.9706 0.9706 0.9599 0.9947
$\begin{array}{c} 0,4500\\ 0,5400\\ 0,5400\\ 0,7500\\ 0,4500\\ 0,5400\\ 0,560\\ 0,$	0.086 0.044 0.022 0.010 0.438 0.324 0.226 0.1508 0.725 0.9425 0.976 0.985 0.976 0.976 0.975 0.976 0.975 0.976 0.975 0.976 0.975 0.976 0.975 0.976 0.975 0.976 0.975 0.976 0.996
0.5400 0.6400 0.7500 0.4500 0.5400 0.6400 0.7500 0.4500 0.6400 0.5400 0.6400 0.7500 0.4500 0.4500 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.5400 0.6400 0.5400 0.5400 0.6400 0.5400 0.5400 0.5400 0.6400 0.5400 0.5400 0.5400 0.6400 0.5400 0.6400 0.5400 0.5400 0.5400 0.5400 0.6400 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500 0.5500	0,044 0,022 0,010 0,438 0,324 0,226 0,1508 0,7958 0,723 0,6407 0,551 0,9429 0,8890 0,8518 0,985 0,9785
0.6400 0.7500 0.4500 0.5400 0.6400 0.7500 0.4500 0.6400 0.5400 0.6400 0.7500 0.4500 0.5400 0.5400 0.5400 0.5400 0.5400 0.5400 0.5400 0.5400 0.5400 0.5400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.5400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5500 0.50	0,022; 0,010; 0,438; 0,324; 0,226; 0,150; 0,723; 0,640; 0,723; 0,640; 0,551; 0,942; 0,942; 0,942; 0,889; 0,851; 0,985; 0,976; 0,976; 0,976; 0,976; 0,996; 0,994;
$\begin{array}{c} 0,7500 \\ 0,4500 \\ 0,5400 \\ 0,5400 \\ 0,7500 \\ 0,4500 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,7500 \\ 0,4500 \\ 0,4500 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,5400 \\ 0,6400 \\ \end{array}$	0,010 0,438 0,226 0,226 0,1508 0,7958 0,7958 0,7239 0,6407 0,551 0,9429 0,9429 0,8890 0,8518 0,9853 0,9706 0,9706 0,9706 0,9947
0,4500 0,5400 0,6400 0,7500 0,4500 0,5400 0,5400 0,7500 0,4500 0,6400 0,7500 0,4500 0,4500 0,4500 0,5400 0,5400 0,5400 0,5400 0,5400 0,5400	0,438 0,324 0,226 0,1508 0,7958 0,723 0,6407 0,551 0,9429 0,9429 0,9192 0,8890 0,9192 0,8890 0,9192 0,8518 0,9853 0,9706 0,9706 0,9599 0,9947
0.5400 0.6400 0.7500 0.4500 0.5400 0.6400 0.7500 0.4500 0.5400 0.5400 0.6400 0.7500 0.4500 0.5400 0.5400 0.5400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400 0.6400 0.6400 0.5400 0.6400 0.5400 0.6400 0.5400 0.6400	0,324; 0,226 0,150; 0,795; 0,723; 0,640; 0,9551; 0,942; 0,919; 0,889; 0,919; 0,889; 0,919; 0,885; 0,978; 0,978; 0,976; 0,976; 0,976; 0,976; 0,976; 0,976; 0,976; 0,976; 0,994; 0,975; 0,994; 0,975; 0,995;
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0,7500 0,4500 0,5400 0,7500 0,4500 0,5400 0,5400 0,6400 0,7500 0,4500 0,4500 0,4500 0,4500 0,6400 0,7500 0,4500 0,5400 0,5400 0,5400 0,6400	0,150 0,795 0,723 0,640 0,551 0,942 0,942 0,942 0,942 0,942 0,945 0,851 0,985 0,978 0,978 0,978 0,978 0,978 0,978 0,978
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7.0000	15.0000	0.7500	0.0115
7.0000	7.5000	0.4500	0.4812
7.0000	7.5000	0.5400	0.3640
7.0000	7.5000	0.6400	0.259
7.0000	7.5000	0.7500	0.1749
7,0000	3.7500	0.4500	0.820
7.0000	3.7500	0.5400	0.7548
7,0000	3.7500	0.6400	0.677
7.0000	3.7500	0.7500	0.592
7.0000	1.8750	0.4500	0.950
7,0000	1.8750	0,5400	0 030
7,0000	1.8750	0,5400	0,900
7.0000	1.8750	0,7500	0,900
7.0000	0 0375	0,7500	0.070
7.0000	0,9375	0.4500	0.907
7.0000	0,9375	0.5400	0,901
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7.0000	0,9375	0.7500	0,905
7.0000	0.4988	0.4500	0,990
	0,4088	0.5400	0,995
7.0000	0,4688	0,6400	0,993
7.0000	0,4088	0.7500	0,991
7.0000	0.2344	0,4500	0,999
• 7.0000	0.2344	0,5400	0,998
7.0000	0.2344.	0.6400	0,998
7.0000	0.2344	0.7500	0,997
7.0000	0,1172	0.4500	0,999
7.0000	0,1172	0.5400	0,999
7.0000	0,1172	0,6400	0,999
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7.0000	0:0586	0,4500	1,000
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8,0000	3,7500	0,5400	0,7000
	3.7500	0,0400	0,7004
8.0000	1 8750	0,7500	0,0214
	1,0750	0,4500	0,9507
<u>0,000</u>	1.0750	0,5400	0.9304
0.0000	1,0750	0.6400	0.9148
8.0000	1.0750	0.7500	0.8054
8.0000	0.9375	0.4500	0,9890
8.0000	. 0,9375	0,5400	0,9841
8.0000	0.9375	0.8400	0,9778
8.0000	0,9375	0,7500	0,9697
8.0000	0,4088	0,4500	0,9972
8.0000	0.4688	0,5400	0,9960
8.0000	0,4688	0,6400	0.9944
8.0000	0.4688	0.7500	0,9923
. 8.0000	0,2344	0.4500	0,9993
8,0000	0.2344	0.5400	0.999(
8.0000	0.2344	0.6400	0,9986
8.0000	0.2344	0,7500	0,9981
8.0000	0,1172	0,4500	0,9998
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8.0000	0,0586	0.4500	1.0000
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9,0000	15.0000	0.6400	0.032
9.0000	15.0000	0.7500	0.014
9.0000	7,5000	0.4500	0.553
9.0000	7.5000	0.5400	0.436
9.0000	7.5000	0.6400	0.324
9.0000	7.5000	0.7500	0.226
9,0000	3,7500	0.4500	0.856
9.0000	3.7500	0.5400	0.800
9.0000	3.7500	0.6400	0.734
9.0000	3,7500	0.7500	0.657
9.0000	1,8750	0.4500	0.961
9.0000	1.8750	0.5400	0.945
9.0000	1.8750	0.6400	0.923
9.0000	1.8750	0.7500	0.897
9.0000	0,9375	0.4500	0.990
9.0000	0.9375	0.5400	0.985
9.0000	0,9375	0.6400	0.980
9,0000	0,9375	0.7500	0.973
9.0000	0.4688	0.4500	0.997
9.0000	0.4688	0,5400	0.996
9.0000	0,4688	0.6400	0.995
9.0000	0,4688	0.7500	0.993
9.0000	0.2344	0.4500	0.999
. 9.0000	0.2344	0.5400	0,999
9.0000	0,2344	0.6400	0,998
9,0000	0,2344	0,7500	0,998
9.0000	0.1172	0.4500	0.999
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10.0000	7.5000	0.4500	0.5831
10.0000	7.5000	0.5400	0,4679
10.0000	7.5000	0.6400	0.3546
10.0000	7.5000	0.7500	0.253(
10.0000	3.7500	0.4500	0.869(
10.0000	3.7500	0.5400	0.8180
10.0000	3.7500	0.6400	0.7558
10.0000	3,7500	0.7500	0.6834
10.0000	1.8750	0.4500	0.9652
10.0000	1.8750	0.5400	0.9503
10.0000	1.8750	0.6400	0.9310
10.0000	1.8750	0.7500	0,9067
10.0000	0.9375	0.4500	0.9911
10.0000	0.9375	0.5400	0.9873
10.0000	0.9375	0.6400	0.9822
10.0000	0.9375	0.7500	0.9756
10.0000	0.4688	0.4500	0.9978
10.0000	0.4688	0.5400	0,9968
10.0000	0.4688	0.6400	0.9955
10.0000	0.4688	0,7500	0.9938
10.0000	0.2344	0.4500	0.9994
10.0000	0.2344	0.5400	0.9992
10.0000	0.2344	0.6400	0.9989
10.0000	0.2344	0.7500	0.9985
10.0000	0.1172	0.4500	0.0000
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	PROGRAM STATEMENT FOR DETERMINATI	ON OF N2	56
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13	PRINT 101,N%IN[,T1%IT[,T29	SITE, TO%ITE,W	1
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35	CALL EXIT		
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00207	1015	103	
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00212	205		n an
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00403	DEL	274,288	
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00417	G	269,272,286	
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VIRTUAL	IOHEF	74,83,116,133	
VIRTUAL	IOHFC.	79,121,126	
VIRTUAL	тоннс.	45,50,55,60,65,70,87,92,97,102,107,112	
VIRTUAL	IOHIO.	73,82,84,115	
VIRTUAL.	IOHLP	76,118,125	
VIRTUAL	IOHRP.	81,123,130	
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VIRIUAL	+ L X M J +	23212491200	and the second state of the species species and states of the second
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00370	M	201.205	elifek Alfahanga alak Sapananan yang Jac Japan Kanaga dari
00422	N	11,180,195,213,251,254	
00436	N1	202,208,210,211,217,230,278	-
00421	N2	215,235,247,280	
00437	NN	252,266	
VIRTUAL	SETFP,	155	•.
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00365	SNGCT.	156,196,209	
VIRTUAL	SQRT	222,239,258	
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00405	10	22,109,180,255	
003/1	11	33110011021219	n An an
00441	1 C	157,188,216,224,253	
00225	0.000	221,225,226,228,229,231,238,242,243,245,245,248,257	261.262.
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00212	5.0045	161,179,212,301	- V
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00000 00362 DATCT. 00000 PLGCT. 00000 PRGCT. 00231 SFLCT. 00362 STRCT.	1-1 4-4,10-43 313-330 2-2,154-312,331-332 3-3,44-133,333-343 5-9,134-153		
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د اور مستقدم است استور باین در این ورم میش مدین و این میشود. ا			ء -
a a sana a sa a sa a sa a sa a sa a sa	21. – Andrea Antonio, and Antonio Antonio. 4.		
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	59	
PHASE ANGLE CALCULATIONS.		n F
MEM	ORY MAP	
SYSTEM, INCLUDING IDCS	00000 THRU	122
FILE BLOCK ORIGIN	12302	
NUMBER OF FILES - 1		
1. S.FBOU	12302	-
OBJECT PROGRAM	12325_THRU	16
1. DECK @DELTA @	12325	
2. SUBR @DUSYFB@	00000	
4 SUBR @CNSTNT@	13114	···· · · · · · · · · · · · · · · · · ·
5. SUBR @FPR @	13123	
6, SUBR @Iŋs @	13124	e
7. SUBR @RWD @	13401	
8. SUBR @LCV @	14061	
	14327	
	14421	
12. SUBR @INTJ @	14545	•••••
13. SUBR @FFC @ *	15061	
14. SUBR @FPT @	15470	
15. SUBR @XEM @ +	16040	-
16. SUBR @XIT @	16251	•
	10203 1430/	
	16/132	
	16432	
%* - INSERTIONS OR DELETION	S MADE IN THIS DECK	-12" / - 1474-14
INPUT - NUTPUT BIJFFERS	77317 THRU	77
UNUSED CORE	16677 THRU	77
		,
	n en en sinte en	alayahay ka saya

TABLE 6

COMPUTER DATA FOR DETERMINATION OF N2 (NUMBER OF PERFECT MIXERS IN FLUIDIZED SECTION)

Nl	N2	AR1	AR ₂	AR	Delta (AR-AR _l •AR ₂)
•2	1.8	.819	.499	.372	,0362
.4	1.6	.751	.511	.372	.0119
.6	1.4	.710	.527	.372	.0020
.8	1.2	.683	•545	.372	.0001
1.0	· 1.0	.663	.568	.372	.0044
1.2	0.8	.648	•597	.372	.0148
1.4	0.6	.636	.637	.372	.0326
1.6	0.4	.626	.693	.372	.0616
1.8	0.2	.618	.783	.372	.1116

3.75 INCH COLUMN N=2

	ΓA	BL	E	7
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COMPUTER DATA FOR DETERMINATION OF N2 (NUMBER OF PERFECT MIXERS IN FLUIDIZED SECTION)

·					
Nl	N2	AR1	AR ₂	AR	Delta (AR-AR _l •AR ₂)
0.2	1.8	.815	.438	.331	.0266
0.4	1.6	•744	.453	.331	.0069
0.6	1.4	.702	.471	.331	.0003
0.8	1.2	.673	.493	.331	.0014
1.0	. 1.0	.652	.520	.331	.0085
1.2	0.8	.636	•554	.331	.0219
1.4	0.6	.623	.600	.331	.0432
1.6	0.4	.613	.664	.331	.0764
1.8	0.2	.604	.765	.331	.1319

5.75 INCH COLUMN N=2

ΓA	BL	Ε	8

COMPUTER DATA FOR DETERMINATION OF N2 (NUMBER OF FERFECT MIXERS IN FLUIDIZED SECTION)

			N=3		
Nl	N ₂	AR1	AR ₂	AR	Delta (AR-AR ₁ •AR ₂)
0.3	2.7	.769	.335	.239	.0188
0.6	2.4	.694	.349	.239	.0035
0.9	2.1	.652	.366	.239	.000003
1.2	1.8	.625	.387	.239	.0031
1.5	1.5	.606	.413	.239	.0118
1.8	1.2	.592	.448	.239	.0265
2.1	0.9	.581	.496	.239	•0494
2.4	0.6	.572	. 567	.239	.0856
2.7	0.3	.564	.687	.239	.1489

7.75 INCH COLUMN N=3
TABLE 9

COMPUTER DATA FOR DETERMINATION OF N2 (NUMBER OF PERFECT MIXERS IN FLUIDIZED SECTION)

ير حي فيه					
Nl	N2	AR1	AR ₂	AR	Delta (AR-AR ₁ ·AR ₂)
0.3	2.7	.769	.282	.205	.0116
0.6	2.4	.694	.297	.205	.0010
0.9	2.1	.652	.316	.205	.0007
1.2	1.8	.625	.338	.205	.0064
1.5	<u> </u>	.606	.367	.205	.0175
1.8	1.2	.592	.406	.205	.0348
2.1	0.9	.581	.458	.205	.0608
2.4	0.6	.572	.536	.205	.1011
2.7	0.3	.564	.666	.205	.170 7

9.75 INCH COLUMN N=3