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Disc size scale-up in rotating biological contactor system

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ABSTRACT

Title of Thesis : Disc Size Scale-up in Rotating Biological Contactor System

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Department of Civil and Environmental Engineering

Disc size scale-up of prototype and small-scale RBC plants are successfully developed by applying the 114 data sets obtained from 12 RBC plants to the evaluation of percent sBOD remaining. These data analyses are performed by the least square method, therefore, the scale-up factors of the prototype and the small-scale are determined at different hydraulic loading. Furthermore, the relationship between scale-up factor and the disc diameter are established under the given flow rate, the number of stages, and the number of discs. A group of Curves are obtained and can be utilized for the full-scale RBC plant preliminary design. The overall calculations are preformed by the computer program.

DISC SIZE SCALE-UP IN

ROTATING BIOLOGICAL CONTACTOR SYSTEM

By

Chi-Sheng Chang

Thesis submitted to the Faculty of the Graduate School of

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I. INTRODUCTION

A. Review of RBC Development

The rotating biological contactor (RBC) process originated in Europe in the late 1950's. The process proved simple to operate, and thus, their use spread quickly through West Germany, Switzerland, France, and other European countries. There are more than 1000 installations in Europe. In 1969, the first commercial installation went into operation through a licensing agreement between Allis-Chalmers and the German manufacturer.

Use of the RBC's grew slowly since the polystyrene discs were limited by installation cost to small scale operations. In 1981, corrugated sheets of polyethylene were used to increase the media surface area/unit of volume.

B. Factors Influcing RBC Performance

In the mid 70's, at least two factors caused an increased number of RBC installations in the U.S.. The first factor was the Clean Air Act, a public law which set up requirements for cleaning up the nation's waterways. It provided funding for new treament plants and improvements for existing plants. The minimum goal was to achieve secondary treament for all point source discharges.

Another factor was energy, which was becoming more scarce and expensive. According to Dr. Wu's math model prediction of RBC wastewater treament systems [1,2,3,11,15], the removal of biological oxygen demands (BODs) in wastewater is closely affected by such variables as the flow rate, temperature, disc surface area, influent nutrient conditions, and liquid retention time. In view of the available wastewater treament capacity concerning the various scale RBC systems, the disc area and the inflow rate are the basic design parameters.

Although hundreds of different scales of RBC system have been studying and using in this country since the last two decade, a great deal of research is still needed in order to achieve and better define the common design creteria and operating characteristics acceptable to all RBC vendors. Wu's model, developing on the basis of full scale RBC data reported by many researchers (1,11,16,17,18) and successfully predicting the effectiveness of BOD removal , can be used to determine the scale-up factors if the operating data are available.

C. Scope of Present Study

In this study, the relating data collected from twelve RBC plants are categorized into three groups according to the scale of the plant. The purpose of this study is via the comparison of the operational data with the model prediction to establish the relationship between the scale-up factor and the disc size for the engineering design reference. The development of the direct scale-up of the various scale RBC plants will lead to considerable savings in cost and will provide a high level of confidence for the designing engineeers.

II. WU'S PREDICTIVE MODEL

A. General Description

Rotating biological contractors (RBCs) are devices which were developed to provide aerobic biological treament of wastewater with or without pretreament. In the case of RBCs, biomass is present simultaneously in the form of attached growth (as in the case of trickling filters) and suspended growth (as for activated sludge units). Since hydraulic residence times are low, and thus the concentration of biomass under suspension is relatively small, most of the BOD removal for RBCs is attributed to the mechanism related to the attached growth.

As formed by multistage or single stage, recycling of effluent back to the early stages of the system has not been practiced because no significant increase in treament efficiency could be associated with this practice. In the RBC treatment process as wastewater flow through the system, biodegradibility is related to some factors such as flow rate, surface hydraulic loading, influent nutrient characteristics, submerged disc depth, disc rotational speed, wastewater retention time and wastewater temperature.

B. Literature Review

A math model can be developed either on a theoretical basis or by multiple regression analysis of experimental data. Joost first described a model for predicting RBC performance as follows:

$$\% \text{ BOD removal} = KL^{a}_{o}T^{b}S^{c}R^{h}N \tag{1}$$

where K is treatability constant of waste material; L_o is the influent concentration of waste material; T is the wastewater temperature; S is the reactor residence time; R is the physical configuration constant which depends on the disc size, spacing thickness, submergence etc.; N is the stage number; a,b,c and h are partial regression coefficients.

Antonie and Welch later suggested that the RBC system performance could be predicted by the following equation :

$$\% \text{ COD removal} = KL_0^{(a+1)^{n}-1}(T^{b}S^{c}B^{d})^{[1-(a+1)]^{n}[1-(a+1)]} \tag{2}$$

where B is the rotational speed; d is the partial regression coefficient, and N, L_0, T, S, K, a, b, and c are the system parameters previously described. However, the values of exponents a, b, c, d, and h in eqs. (1) and (2) were not clearly discussed by Antonie and Welch.

In 1974, Weng and Molof proposed a model that included the effect of flow rate on the performance of a multiple-stage RBC system:

$$F = KL_0{}^{a}T^{b}S^{d}B^{d}A^{e}D^{f}Q^{g} \tag{3}$$

where F is the fraction of influent loading remaining in the effluent; Q is the flow rate; A is the total effective disk surface area; D is the submerged disk depth, e, f, and g are the partial regression coefficients, and the other parameters such as L_0, T, S, B, a, b, and c are as previously defined.

C. Wu's Model

In 1982, Wu et al and his associates formulated a emperical model which predicted the soluble BOD (sBOD) reduction in RBC system based on the data reported earlier for full-scale RBC plant studies [3,19]. This model was given as follows :

$$R_m = \frac{14.2\ q^{0.5579}}{\exp^{0.32\ N}\ L_o^{\ 0.6837}\ T^{0.2477}} \qquad (4)$$

R_m = the fraction of influent soluble BOD remaining in effluent

q = surface hydraulic loading (i.e flow rate divided by disk surface area, Q/A), gpd/sf

N = Number of stages

L_o = the influent soluble BOD (sBOD) concentration, mg/L

T = wastewater temperature, ^oC

Eq.(1) indicated that the significant variables influencing the efficiency of RBC plant performance include hydraulic loading, numberof stages, influent sBOD concentration, and wastewater temperature. It predicts that better percent removal is achieved when the hydraulic loading is lower, the number of stages is higher, the influent sBOD strength is higher and the temperature is higher.

It can be seen that the R_m value always decreases as $L_o$and N increase. But R_m value decreases as q decreases. The influence of stage number N on R_m under different conditions for q and L_o at T = 20°C is shown in Fig.II- 1 , which indicates the reduction of the soluble BOD increases rapidly as a result of either increasing both $L_o$and N or decreasing q. However, R_m value changes only 1slightly when N is greater than 6. This result becomes definite when q is low and L_o is high [2].

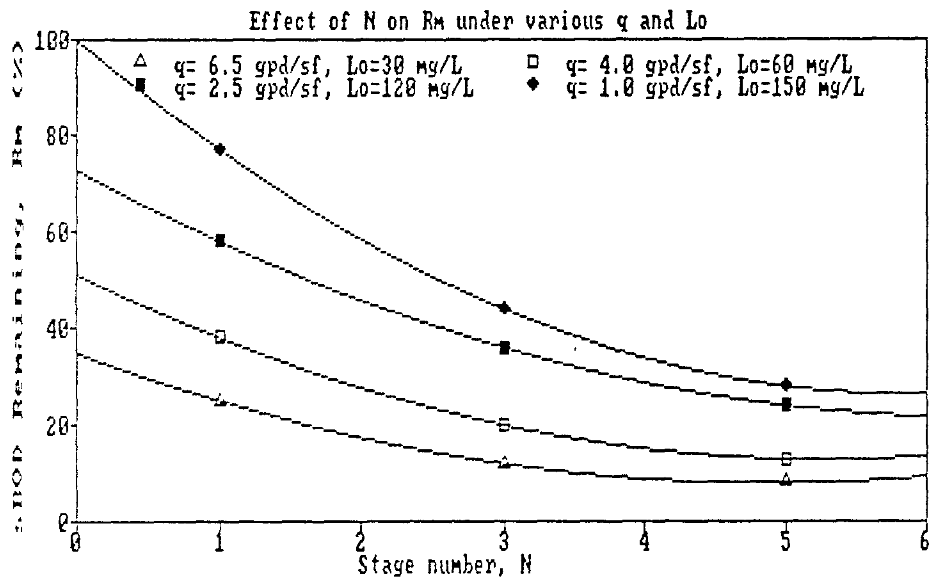


Figure II-1. Effect of N on R_m under various q and L_o

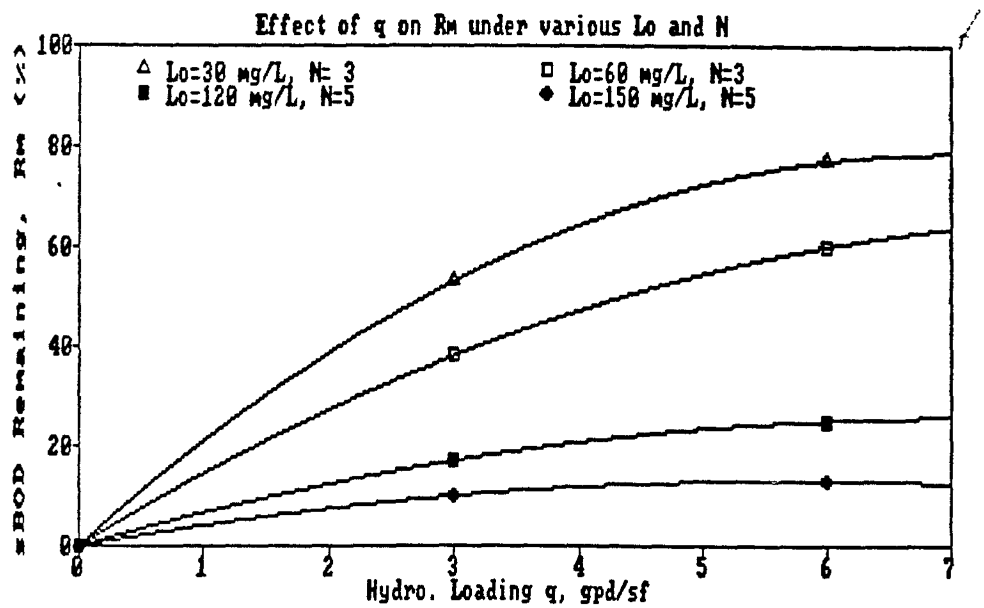


Figure II-2. Effect of q on R_m under various L_o and N

The effects of hydraulic loading, q, on R_m under varying influent sBOD concentration, L_o, and number of stages N, with a temperature of 20^oC is shown in Fig.II- 2 . It can be seen that the R_m value always decreases as a result of either increasing L_o, N, or decreasing q [2].

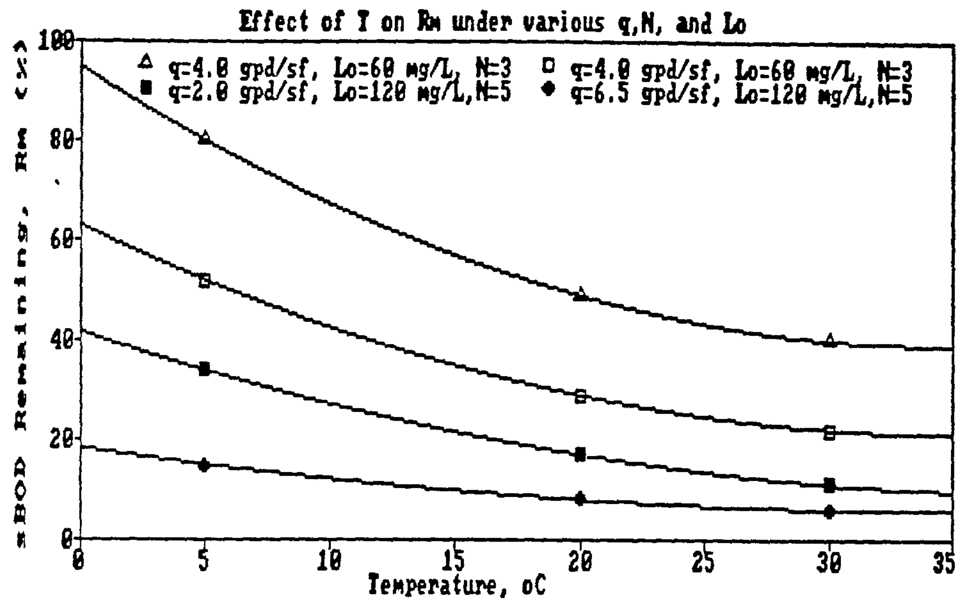


Figure II-3. Effect of T on R_m under various q, L_o, and N

The relationship between T and R_m under varying q, L_o, and N is shown in Fig.II- 3. The R_m value always decreases as either increasing N, L_o or decreasing q. However, R_m decreases slightly as temperature is greater than 15^oC, and N is greater than 2. When the wastewater temperature falls below 15^oC, the effects of L_o, q, and N on R_m become more significant, according to this model [2].

Based on the previous literature, the reliability and accuracy of this model has been extensively studied by using more than 80 data sets obtained from the operation of six full-scale RBC plants [15] of this country. The standard deviation of the observed and predicted R_m is found to be 4.64 % .

III. RBC OPERATING PLANTS AND DATA

A. RBC Operating Plants

In this study, 12 treament data are collected from different area in this country from 1976 to 1986. Three different scale RBC plants based on various disc sizes. The disc size of full-scale plants is greater or equal than 12 ft. Those plants are classified as small-scale if disc diameter D is from 1 ft to 4 ft. The discharge ranged from 5 ft to 10.5 ft is classified as prototype. Twelve plants are listed below :

1. Small-scale RBC plants
   a. RCA unit in Saskatchewan, Canada (D=1.0 ft)
   b. Radford Army Ammunition Plant in U.S.A. (D=1.64 ft)
   c. Pilot Plant at Rhode Island (D=1.64 ft)
   d. Autotrol Company Pilot Plant (D=2.0 ft)
   e. Yankee Grey Hound Inc. Dog Track-Pilot Plant (D=4.0 ft)
2. Prototype RBC plants
   a. Pekaukee Treament Plant (D=5.74 ft)
   b. Pilot Plant at Pullman, Washington (D=6.56 ft)
   c. Pilot Plant at Madison, Metropolitan Sewerage Dist., WC. (D=10.5 ft)
3. Full-scale RBC plants
   a. Full-scale RBC plant of Enviroquip Inc., Austin, TX (D=11.7 ft)
   b. Grawfordsville Wastewater Treament Plant (D=12 ft)
   c. Wastewater Treament Plant in Princeton, Illionis (D= 12 ft)
   d. Autotrol Corporation in Milwaukee, Wis. (D=12.0)

Most of the plants treated both the domestic wastewater and the industrial wastewater. Because of the treament capacity of the influent sBOD can not exceed 500 mg/L in Wu's model, the data are collected and checked to be in accord with this request by Wu's model.

B. Data

The corresponding data of each plant are included in the input data, and also appear in the program outputs shown in the Appendix A and B.

IV. COMPARISON OF sBOD REMAINING BETWEEN OPERATION AND PREDICTION

A. Evaluation of Operational Value R_{m1} And Predictional Value R_{m2}

The operational data described at previous section can be used to estimate the R_{m1}, the fraction of sBOD remaining, through using the effluent concentration divided by the influent concentration. The evaluation of predictive value R_{m2} is performed by Eq. (1). The calculation is via computer program, 'RBC1.c', developed by the author. The input and output data are included in the Appendix B.

B. Comparison of R_{m1} And R_{m2}

From Fig.IV- 1 to Fig.IV- 3, the fraction of sBOD remaining decreases as the stage number N increases. Basically the difference between R_{m1} and R_{m2} becomes smaller and smaller as the stage number increases. The influence on Rm is less significant when N are high. In each scale, the difference at the first stage is usually high, however, it reduces quickly and eventually has an error which is approximately to be 6 % . It becomes small as the plant scale is enlarged. The differences between operating data and predictive values of each run at each scale are shown in Fig.IV- 4 to Fig. IV-6. Full-scale has better performance in sBOD reduction than that of small-scale.

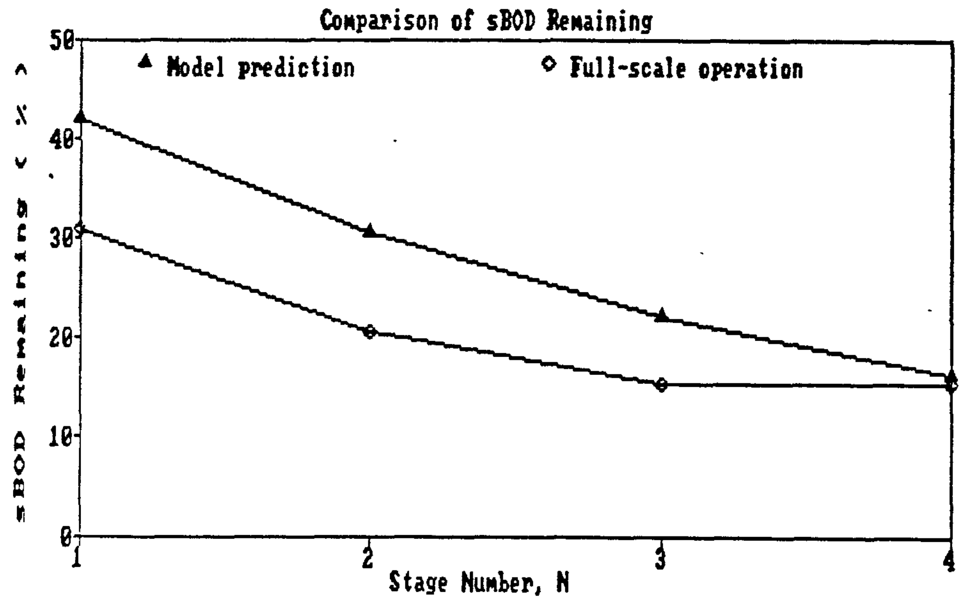


Figure IV-1 Comparison of R_{m1}(full-scale) with R_{m2} under varying N

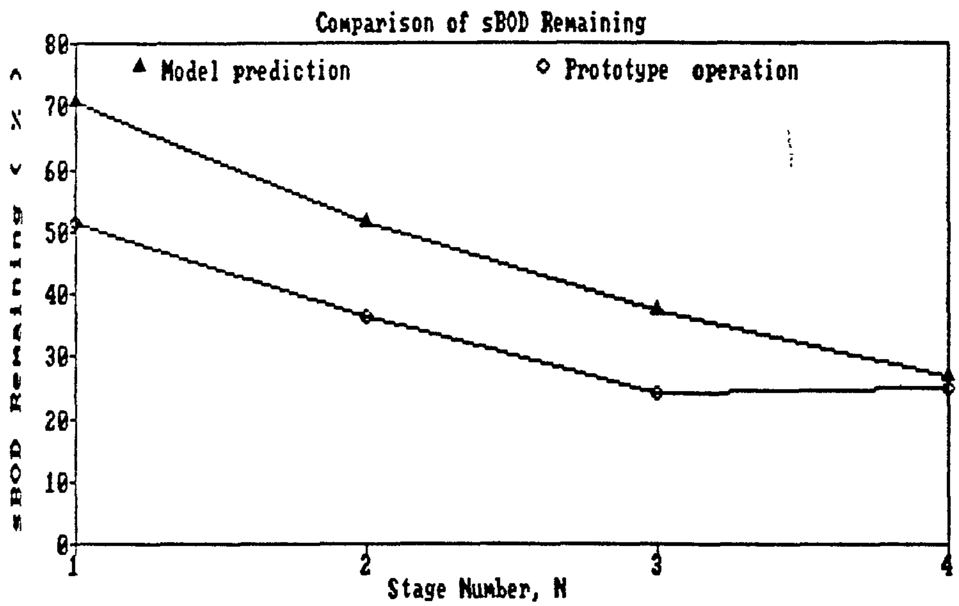


Figure IV-2 Comparison of R_{m1}(prototype) with R_{m2} under varying N

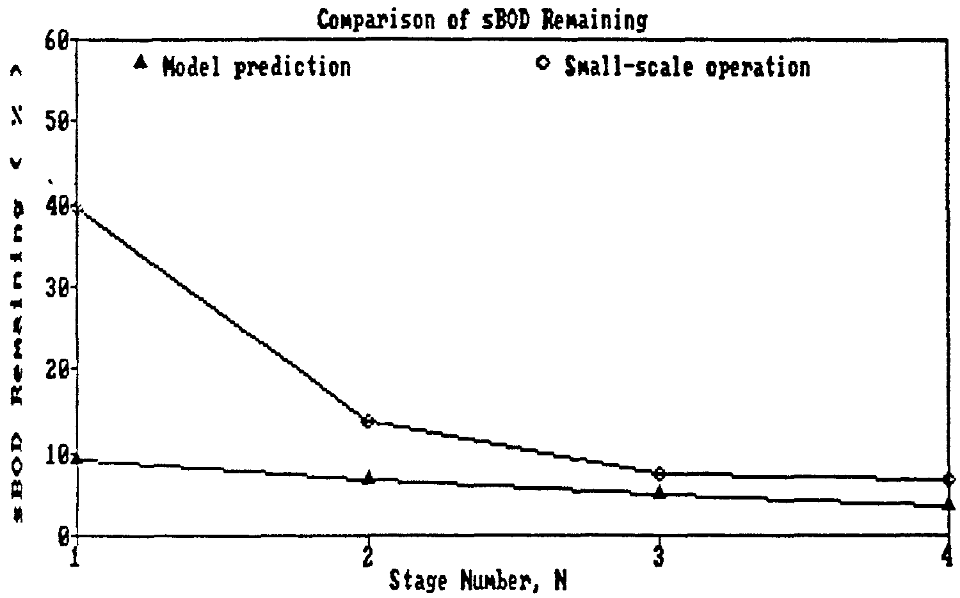


Figure IV-3 Comparison of R_{m1}(small-scale) with R_{m2} under varying N

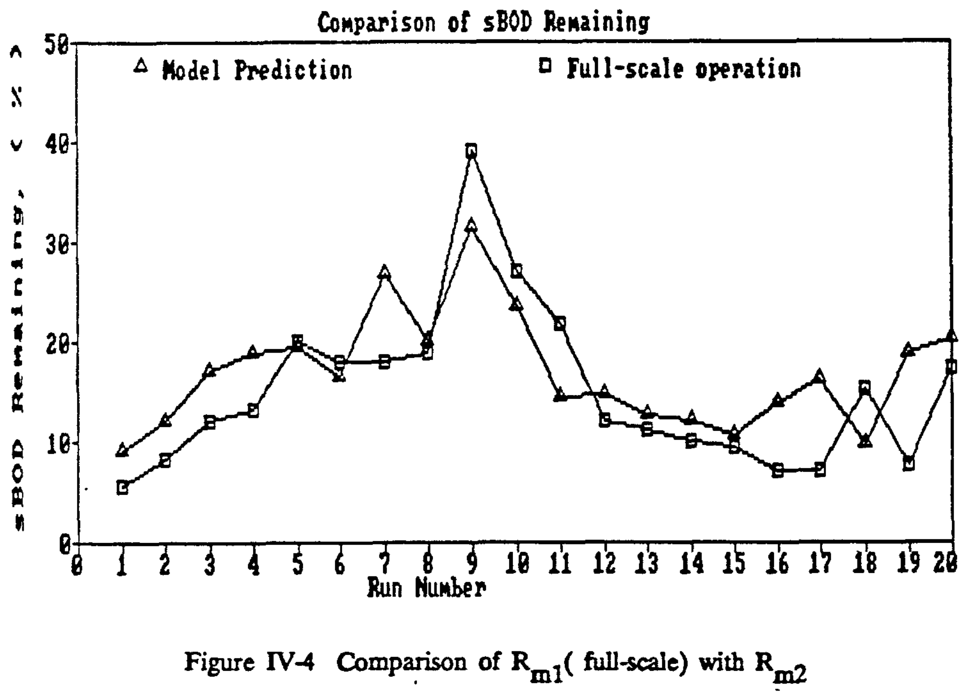


Figure IV-4 Comparison of R_{m1}(full-scale) with R_{m2} under various run

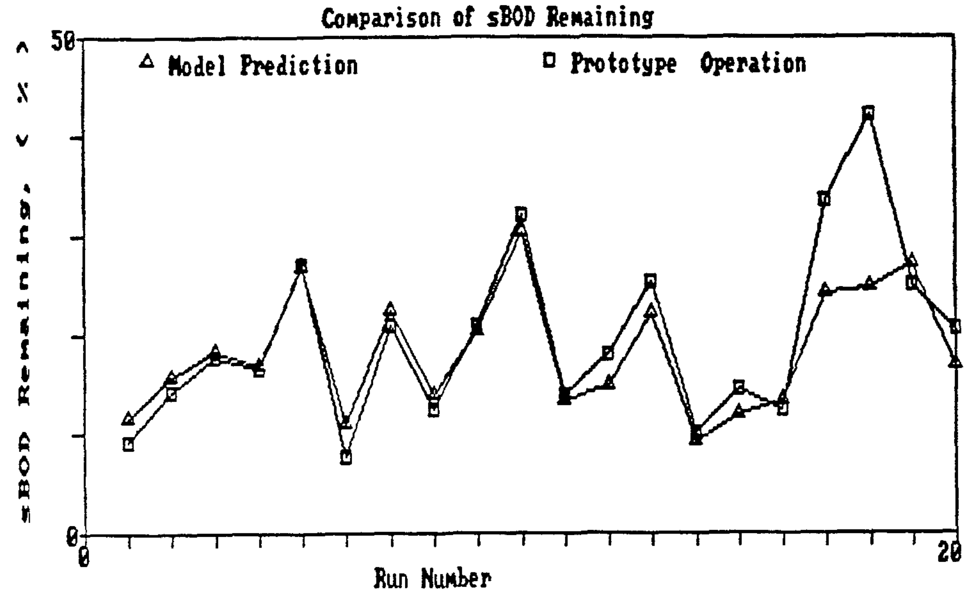


Figure IV-5 Comparison of R_{m1}(prototype) with R_{m2} under various run

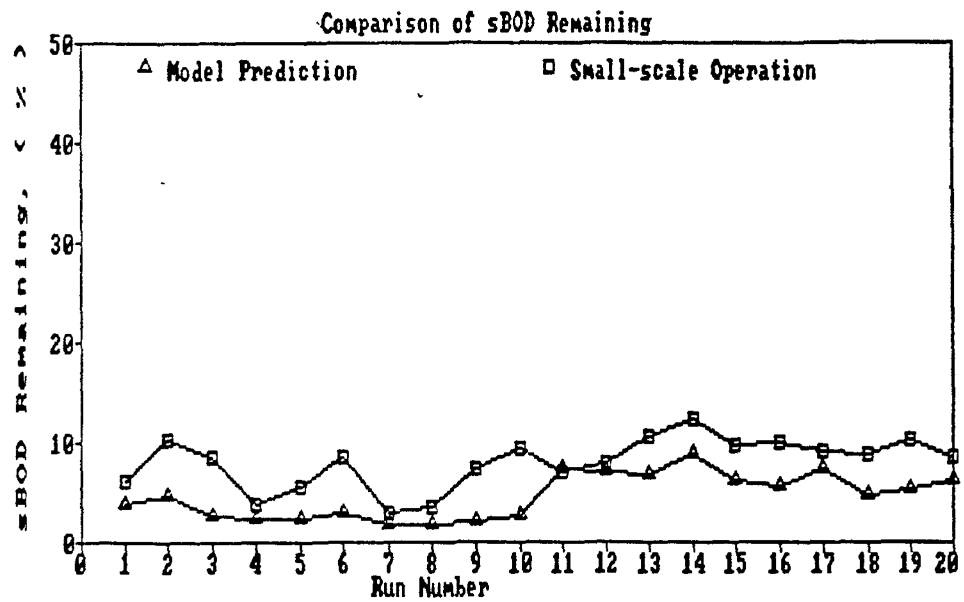


Figure IV-6 Comparison of R_{m1}(small-scale) with R_{m2} under various run

V. DETERMINATION OF SCALE-UP FACTORS

Before a group of factors could be obtained for the disc scale-up of RBC plants, the relationship between P (= R_m / R_{ef}) and q in the equation of each scale needs to be created, and then from which two different scale geometric curves are obtained by calculating the ratios, P_s / P_f and P_p / P_f . These ratios are exactly the scale-up factors (SUs). Furthermore, we decompose the hydraulic loading q and find the term $1/ D^2$, by which our requirement, the relationship between scale-up factor and the disc size, is eventually achieved.

A. The Relationship Between q And P

According to the equations (5), (6), and (7), the ratio P is equal to R_m divided by R_{ef} which include a given hydraulic loading q_c, a fixed value provided as a referenced value. R_m and R_{ef} are under the same operating conditions, N, L_o , and T except for the q_c .

$$R_{ef} = \frac{14.2\ q_c^{0.5579}}{\exp^{0.32N} L_o^{0.6837} T^{0.247}} \qquad (5)$$

$$P_1 = \frac{R_{m1}}{R_{ef}} = \frac{R_{m1}}{\dfrac{14.2\ q_c^{0.5579}}{\exp^{0.32\ N}\ L_o^{0.6837}\ T^{0.2477}}} \qquad (6)$$

$$P_2 = \frac{R_{m2}}{R_{ef}} = \frac{\dfrac{14.2\, q^{0.5579}}{\exp^{0.32N} L_o^{0.6837} T^{0.2477}}}{\dfrac{14.2\, q_c^{0.5579}}{\exp^{0.32N} L_o^{0.6837} T^{0.2477}}} \qquad (7)$$

q_c : Referenced Hydraulic Loading (= 1.5 gpd/sf)

R_{m1}: Fraction of sBOD remaining (operational value)

R_{m2}: Fraction of sBOD remaining (predictive value)

R_{ef}: Fraction of sBOD remaining for reference, ($q = q_c =$ 1.5 gpd/sf)

R_{ef} in Eq.(6) is different from R_m in Eq.(4) because it is calculated at a referenced hydraulic loading, q_c, instead of q. The ratios of R_{m1} to R_{ef} and R_{m2} to R_{ef} are designated as P_1 and P_2 respectively.

RBC pilot plants are classified as three different scales in accord with their disc diameter. Small-scale ranges from 1 ft to 4 ft, prototype 5 ft to 10 ft, and full-scale above 12 ft. From Fig.V- 1 to Fig.V- 3 , the ratio P of each scale is illustrated by a curve which is obtained from the data analysis by a nonlinear least square method. Fig.V- 4 shows the comparison of P_1 for three different scale RBC plants. Fig.V- 5 to Fig.V- 7 show the difference between P_1 derived from the pilot plant operation, and P_2 derived from Wu's predictive model.

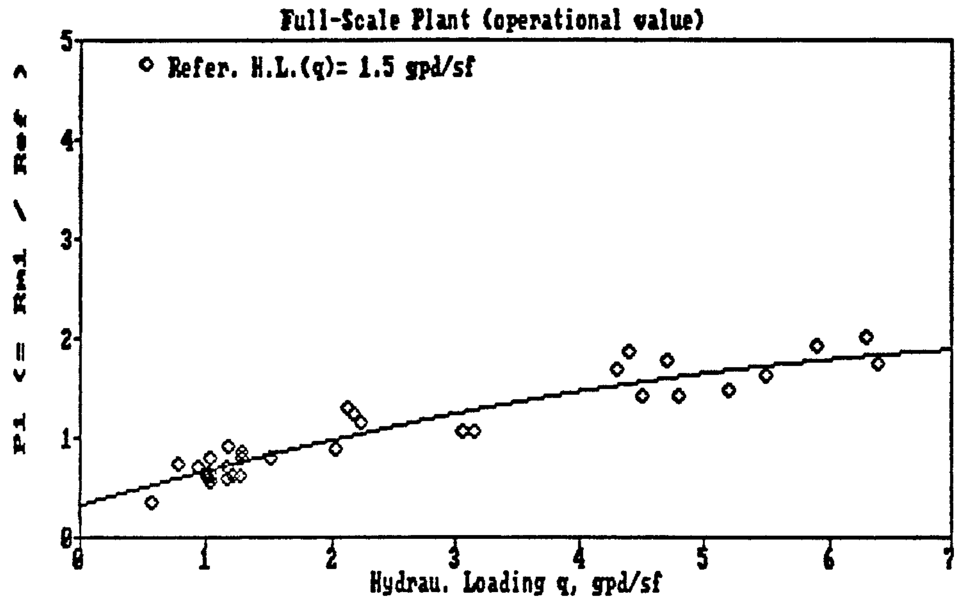


Figure V-1 Full-scale P_1 (R_{m1}/ R_{ef})

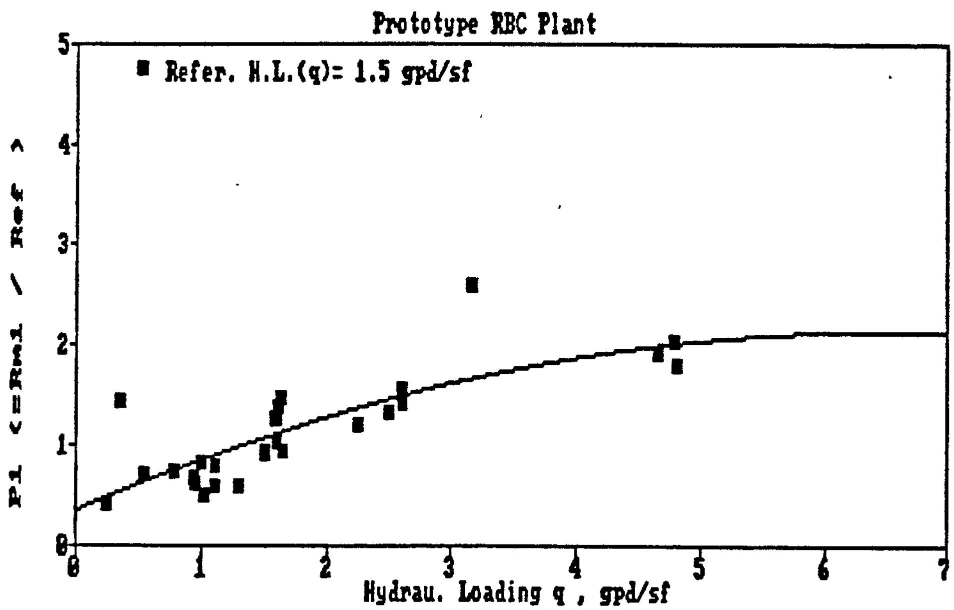


Figure V-2 Prototype P_1(R_{m1}/ R_{ef})

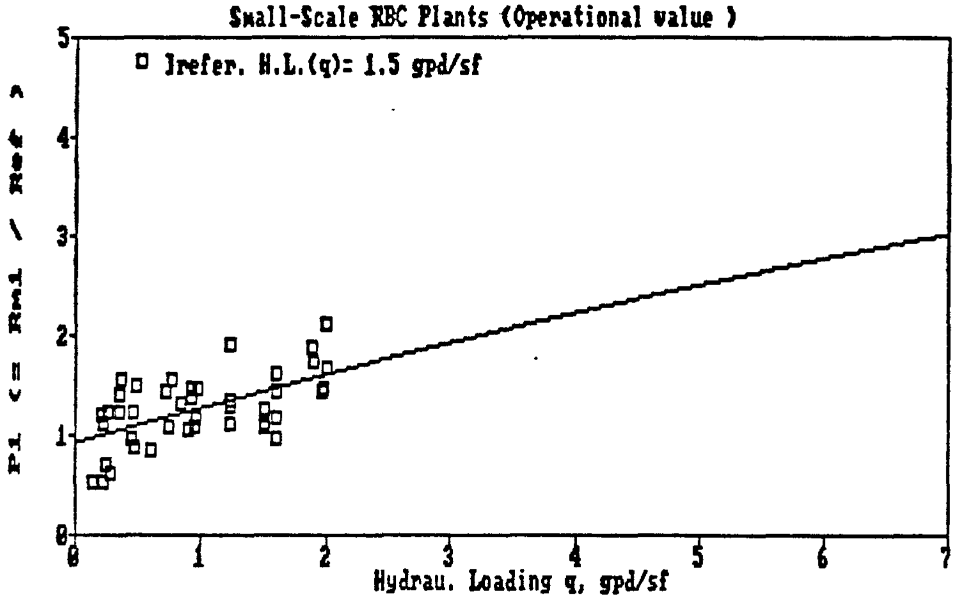


Figure V-3 Small-scale P_1 (R_{m1}/ R_{ef})

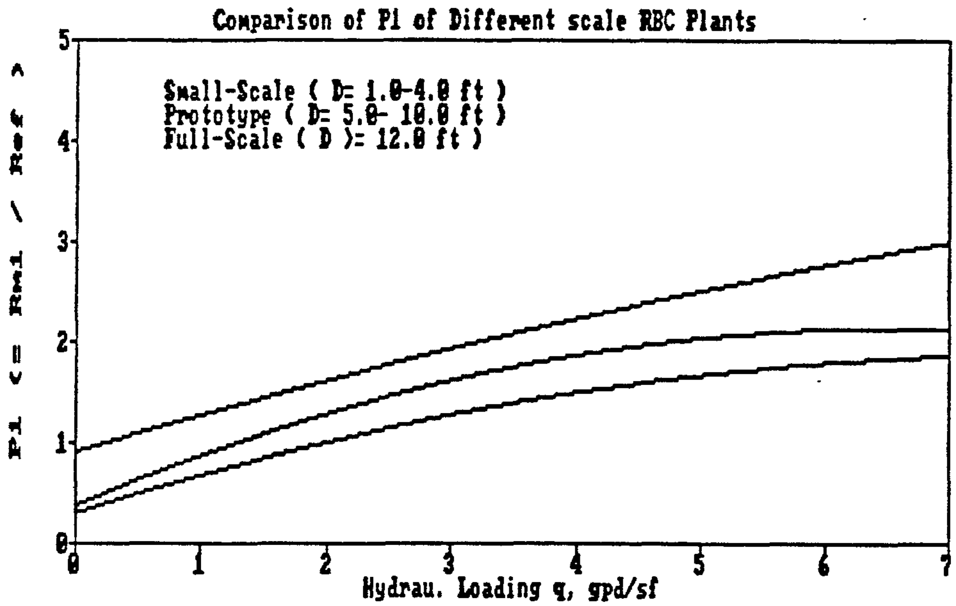


Figure V-4 Comparison of different scale P_1

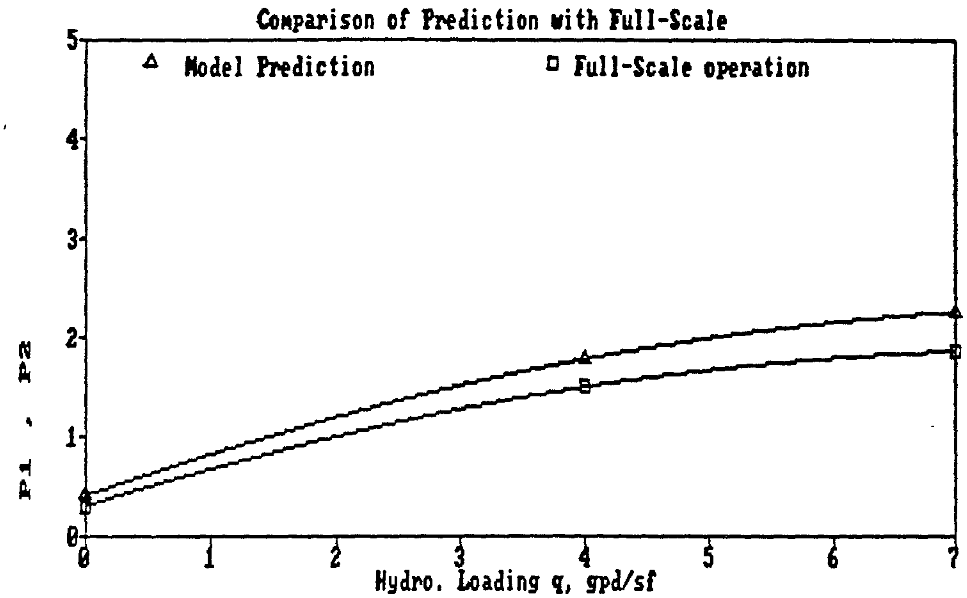


Figure V-5 P_1(full-scale) compared with P_2(prediction)

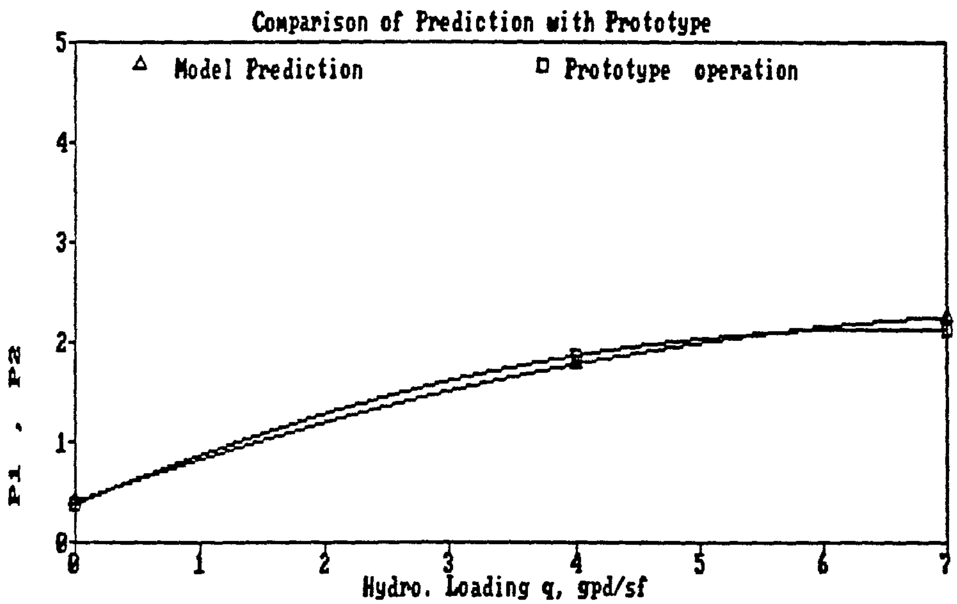


Figure V-6 P_1(prototype) compared with P_2(prediction)

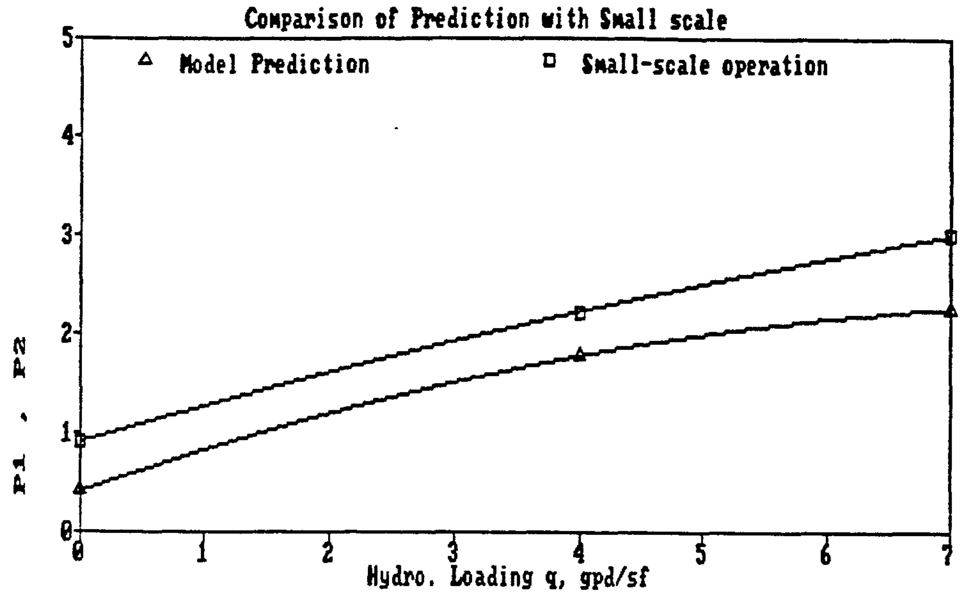


Figure V-7 P_1(small-scale) compared with P_2(prediction)

Genereally the curves of full-scale and prototype can closely fit that of the predictive model, but the small-scale has a large deviation. It corresponds to the previous premise that Wu's model was developed on the basis of full-scale RBC data [2]. The deviation increases significantly as the hydraulic loading is greater than 4.0 gpd/sf. From Fig.V- 4, the larger the scale, the small the value P is. In other words, the sBOD remaining percentage increases as the scale becomes smaller and smaller. So, full-scale RBC plants have higher removal efficiency than that of the prototype and the small-scale RBC plants.

B. The Determination of Scale-Up Factors in Terms of q

$$P_f(q) = -0.02517\ q^2 + 0.3969\ q + 0.305 \tag{8}$$

$$P_p(p) = -0.04\ q^2 + 0.529\ q + 0.38 \tag{9}$$

$$P_s(q) = -0.0101\ q^2 + 0.3679\ q + 0.91 \tag{10}$$

$$Su_1 = \frac{P_s(q)}{P_f(q)} \tag{11}$$

$$SU_2 = \frac{P_p(q)}{P_f(q)} \tag{12}$$

P_s: the ratio of small-scale

P_p: the ratio of prototype

P_f: the ratio of full-scale

SU_1: scale-up factors derived from the ratio P_s to P_f

SU_2: scale-up factors derived from the ratio P_p to P_f

$$SU_s = 0.0465\ q^2 - 0.4147\ q + 2.345 \tag{13}$$

$$SU_f = -0.00405\ q^2 + 0.0102\ q + 1.272 \tag{14}$$

SU_s: scale-up factors of small-scale RBC pilot plants

SU_f : scale-up factors of prototype RBC pilot plants

The scale-up factors are obtained via doing the calculations of the ratios Eq.(9)/Eq.(8) or Eq.(10)/Eq.(8) by the computer program 'rbc1.c' and finding a best fit equation of each curve by the least square method. Two curves are shown in Fig.V- 8 and Fig.V- 9 . Eq.(13) and Eq.(14) exactly show the scale-up factors in terms of hydraulic loading q.

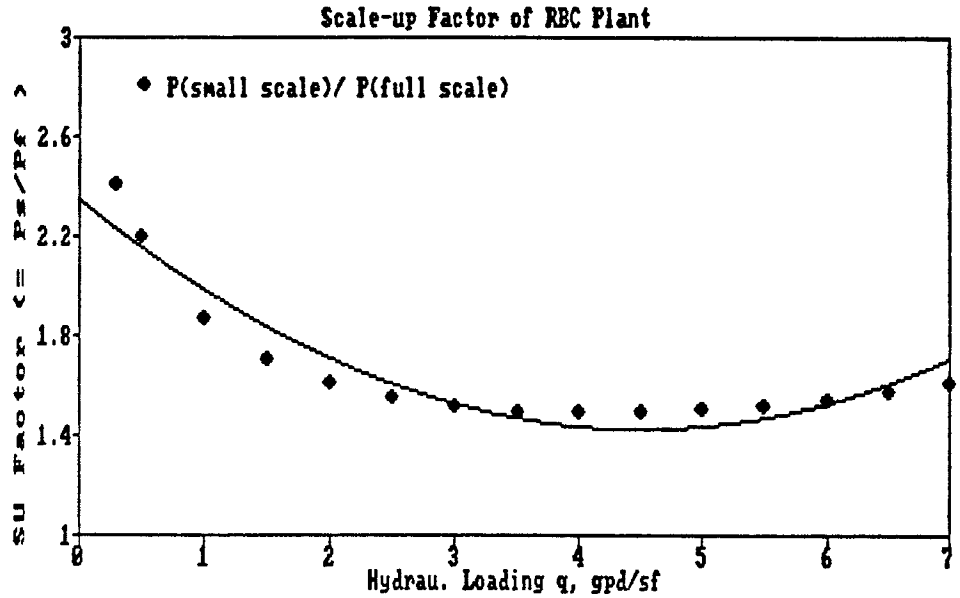


Figure V-8 Scale-up factors of small-scale in terme of q

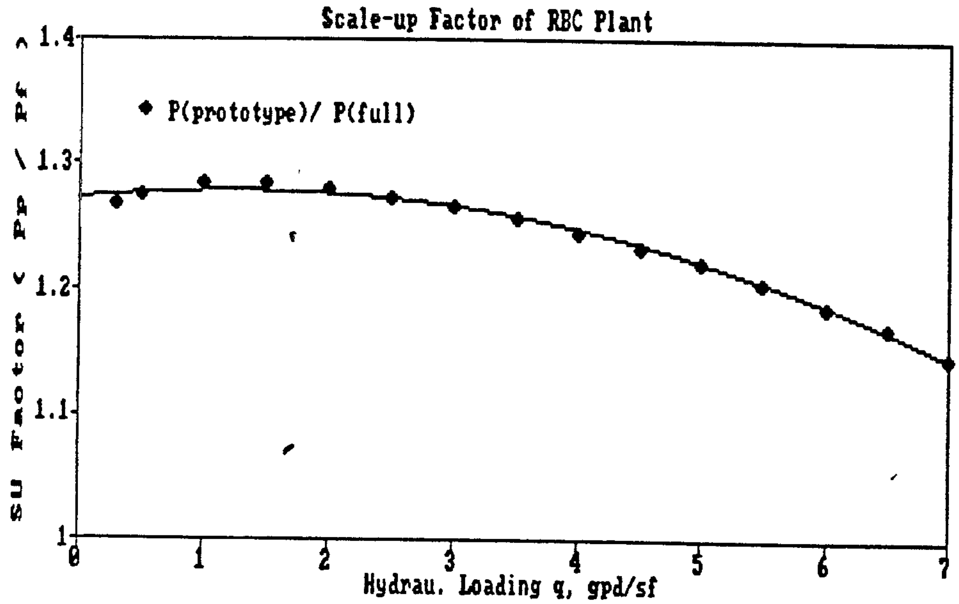


Figure V-9 Scale-up factors of prototype in terms of q

For the prototype RBC plants, the scale-up factors are approximately to 1.27 and change slightly as the hydraulic loading q is less than 3.5 gpd/sf , but they decrease significantly as q is greater than 3.5 gpd/sf. It indicates that the removal efficiency of prototype is closer to that of full-scale RBC plants at higher hydraulic loadings.

For the small-scale RBC plants, the scale-up factors decrease from 2.4 to 1.5 as q increases from 0.3 to 4, and changes slightly as q is greater than 4.

So, Basically either the prototype or the small-scale RBC plants have smaller scale-up factors at higher hydraulic loadings.

C. The Determination of Scale-Up Factors in Terms of $1/D^2$

The hydraulic loading q is directly proportional to the flow rate and inversely proportional to the number of stages, the number of discs, and the disc areas. Eq.(15) shows their relationship. Scale-up factors of both prototype and the small pilot plants can be expressed as a function of $1/D^2$ by substituting the Eq.(15) into Eq.(13) and Eq.(14) respectively. A series

$$q = \frac{2Q}{\pi N N_d} \left(\frac{1}{D^2}\right) \tag{15}$$

$$SU_s = 0.0465\left(\frac{2Q}{\pi N N_d}\right)^2\left(\frac{1}{D^2}\right) - 0.4147\left(\frac{2Q}{\pi N N_d}\right)\left(\frac{1}{D^2}\right) + 2.345 \tag{16}$$

$$SU_p = -.00405\left(\frac{2Q}{\pi N N_d}\right)^2\left(\frac{1}{D^2}\right) + .0102\left(\frac{Q}{\pi N N_d}\right)\left(\frac{1}{D^2}\right) + 1.272 \tag{17}$$

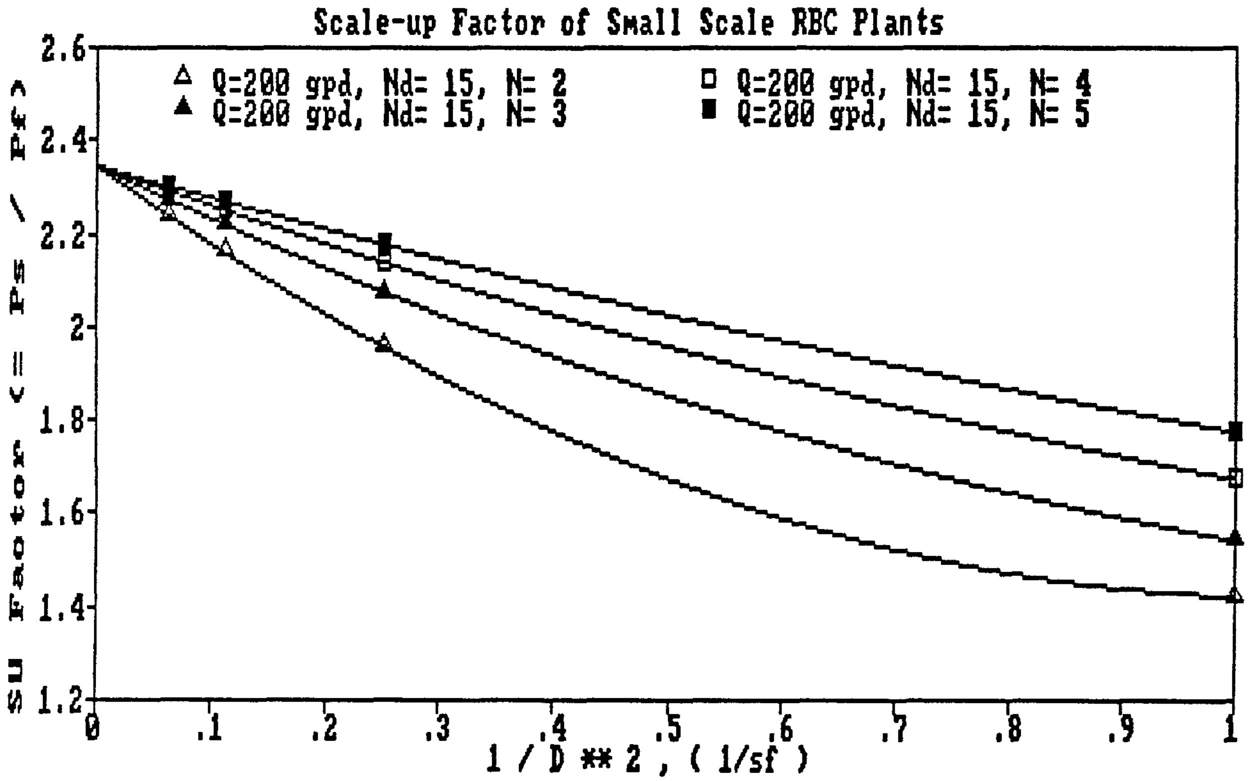
of curves can be created by the combinations of different fixed values Q, N, and N_d in Eq.(16) and Eq.(17). The flow rate Q ranges form 200 to 2200 gpd, the number of stages N from 2 to 5, and the number of discs N_s from 15 to 45 according to the different dimension of the small-scale RBC plants. For the prototype, the flow rate Q ranges from 4000 to 32000 gpd, the number of stages N from 2 to 5, and the number of discs N_d form 15 to 45.

From Fig.V-10 to V-35 , the relationship between SU and $1/D^2$ for the small-scale RBC plants is shown at different operating conditions, Q, N, and N_d. The smaller the number of stages, the larger the scale-up factors are. In other words, under the same size of discs, the fraction of sBOD remaining of small-scale becomes closer to that of full-scale as the number of stages increases.

In addition, at the given Q, N, and N_d , increasing the disc diameter leads to the decrease of hydraulic loading and the increase of scale-up factors, therefore, enlarge the ratio of P_s to P_f and increase the sBOD removal efficiency. However, the increase of disc size can not be over 4 ft, the upper limit of the small-scale disc diameter.

From Fig.V-36 to Fig.V-64 , the relationship between SU and $1/D^2$ for the prototype RBC plants is illustrated under different operational values Q, N, and N_d . The higher the scale-up factors, the less the number of stages is. It indicates that under the same size of discs, the sBOD remaining of prototype becomes closer to that of the full-scale as the value N increased.

Under the given Q, N, and N_d , the increase of the disc diameter results in the decrease of hydraulic loading and the change of scale-up factors. The change is slightly as N is equal to 4 or 5. The scale-up factors decrease significantly as N is equal to 2 . However, the increase of disc size can not be over 10.5 ft, the upper limit of the prototype disc diameter.



Scale-up Factor of Small Scale RBC Plants
Q=200 gpd, Nd= 15, N= 2
Q=200 gpd, Nd= 15, N= 3
Q=200 gpd, Nd= 15, N= 4
Q=200 gpd, Nd= 15, N= 5
SU Factor (= Ps / Pf)
1 / D ** 2 , (1/sf)

Figure V-10

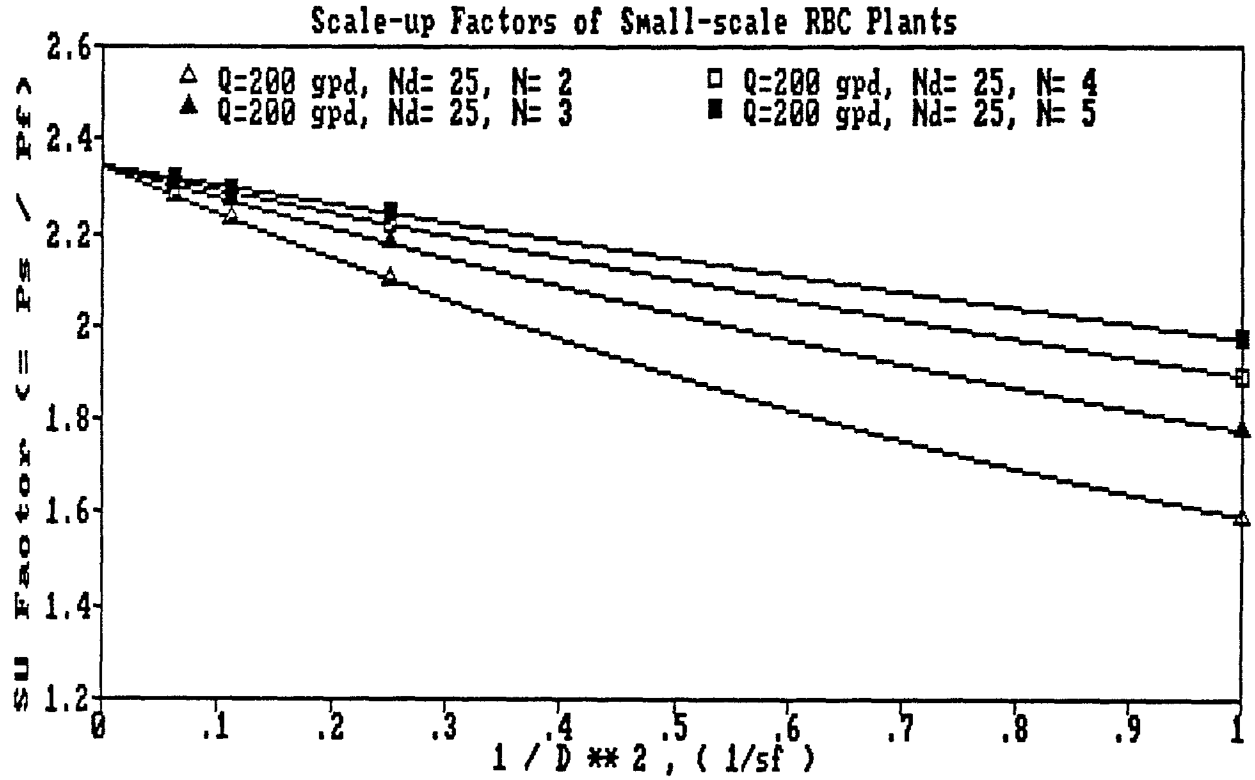

Scale-up Factors of Small-scale RBC Plants
SU Factor (= Ps / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
Q=200 gpd, Nd= 25, N= 2
Q=200 gpd, Nd= 25, N= 3
Q=200 gpd, Nd= 25, N= 4
Q=200 gpd, Nd= 25, N= 5
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-11

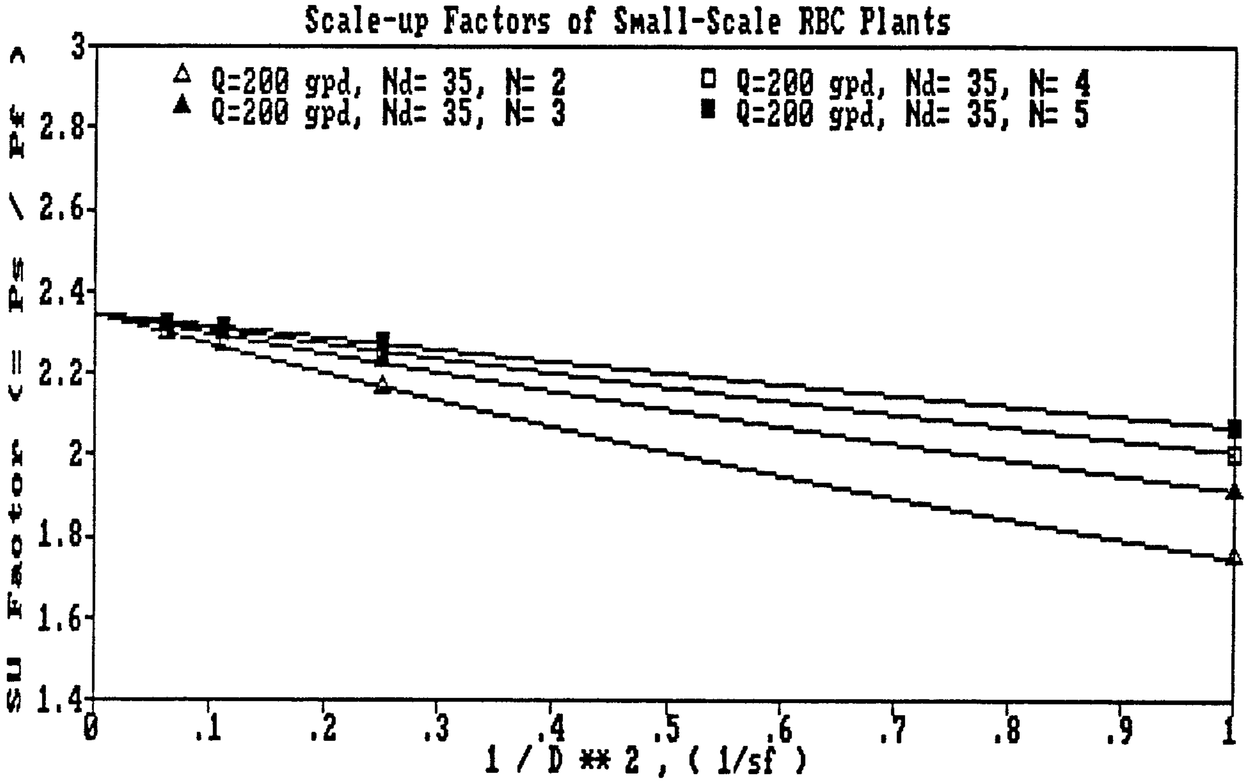
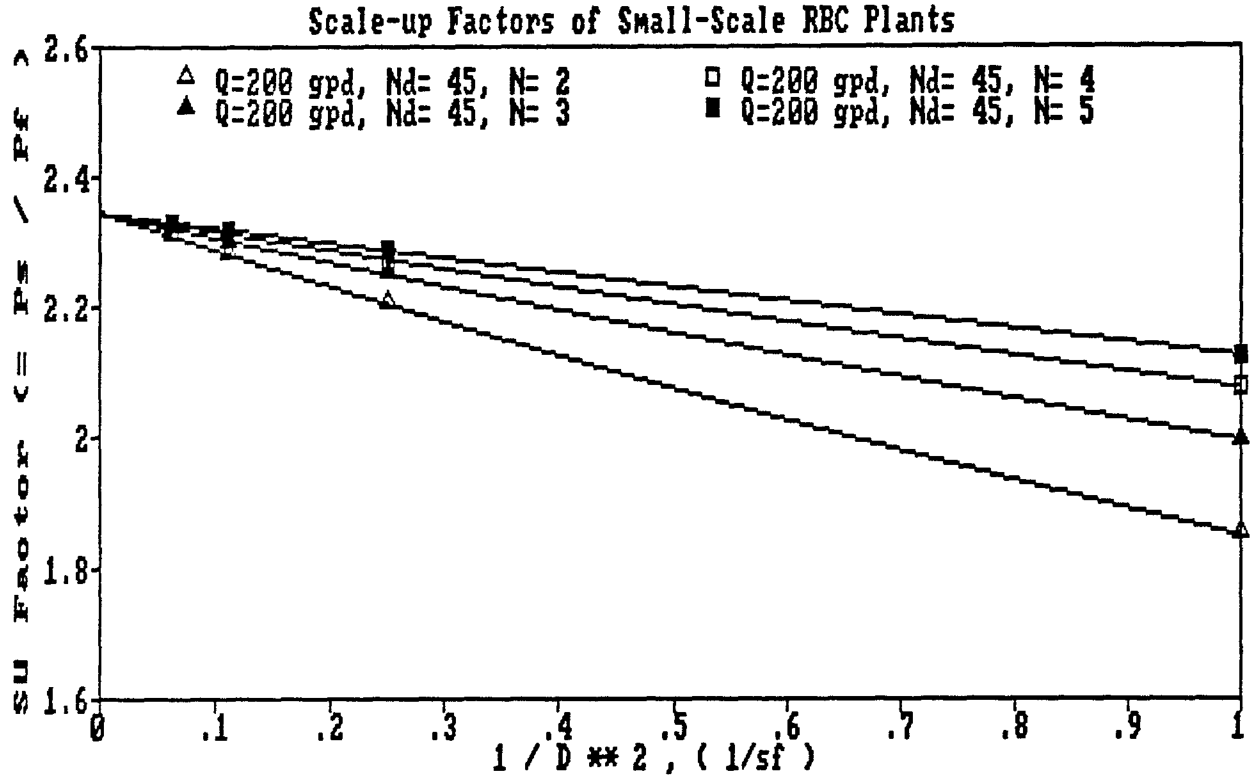

Scale-up Factors of Small-Scale RBC Plants
Q=200 gpd, Nd= 35, N= 2
Q=200 gpd, Nd= 35, N= 3
Q=200 gpd, Nd= 35, N= 4
Q=200 gpd, Nd= 35, N= 5
SU Factor (= Ps / Pf)
1 / D ** 2 , (1/sf)
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1

Figure V-12



Scale-up Factors of Small-Scale RBC Plants
Q=200 gpd, Nd= 45, N= 2
Q=200 gpd, Nd= 45, N= 3
Q=200 gpd, Nd= 45, N= 4
Q=200 gpd, Nd= 45, N= 5
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-13

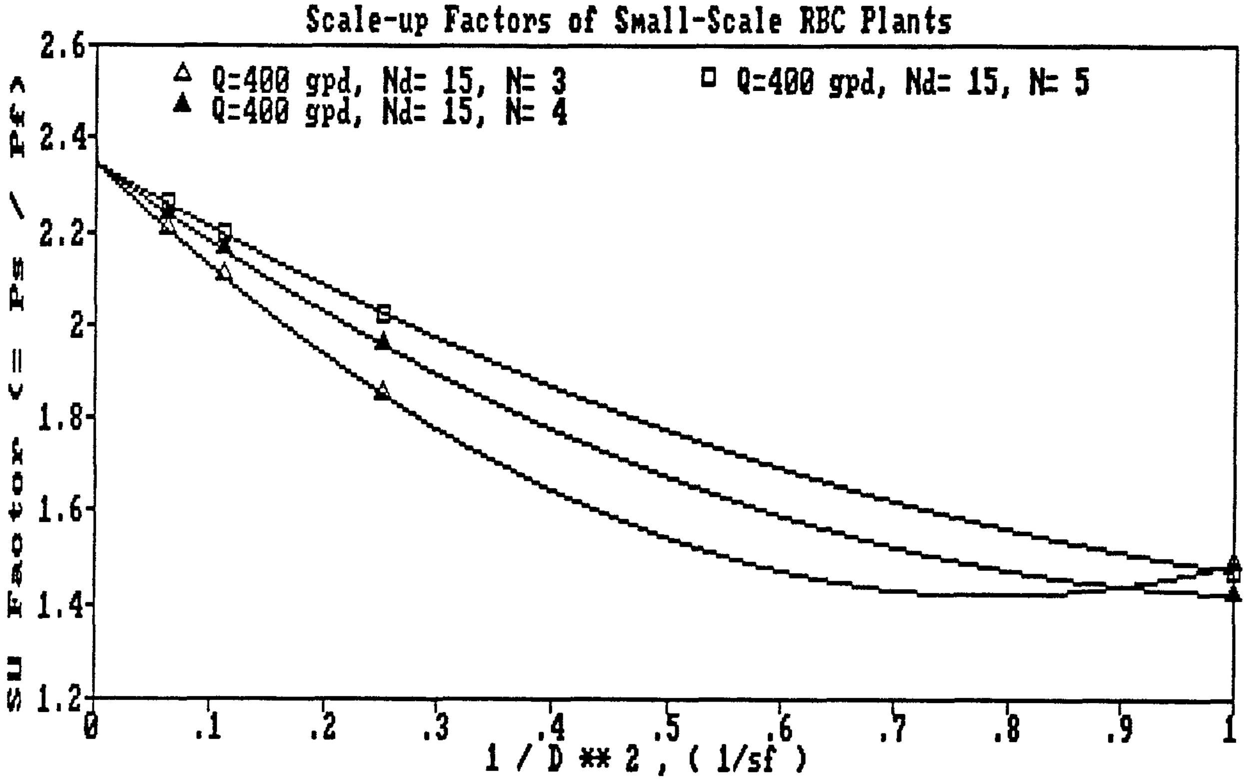

Scale-up Factors of Small-Scale RBC Plants
Q=400 gpd, Nd= 15, N= 3
Q=400 gpd, Nd= 15, N= 4
Q=400 gpd, Nd= 15, N= 5
SU Factor (= Ps / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-14

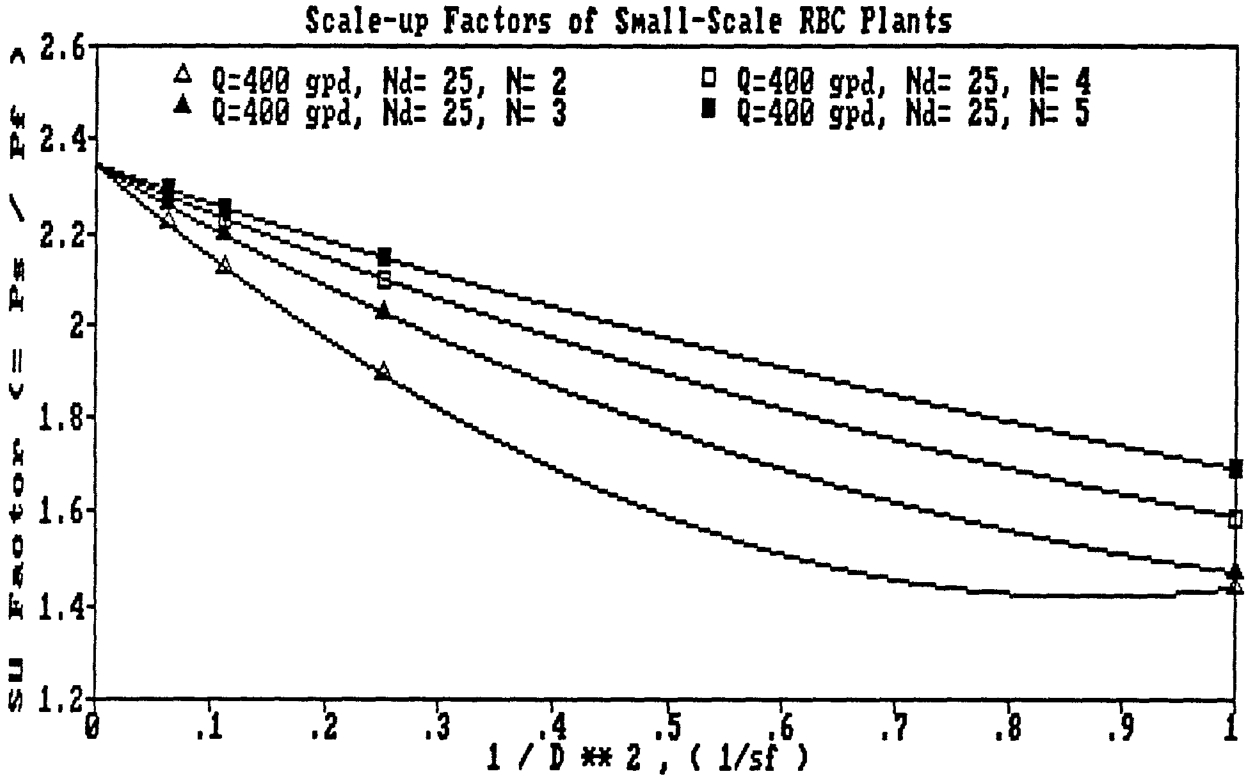

Scale-up Factors of Small-Scale RBC Plants
Q=400 gpd, Nd= 25, N= 2
Q=400 gpd, Nd= 25, N= 3
Q=400 gpd, Nd= 25, N= 4
Q=400 gpd, Nd= 25, N= 5
SU Factor (= Ps / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-15

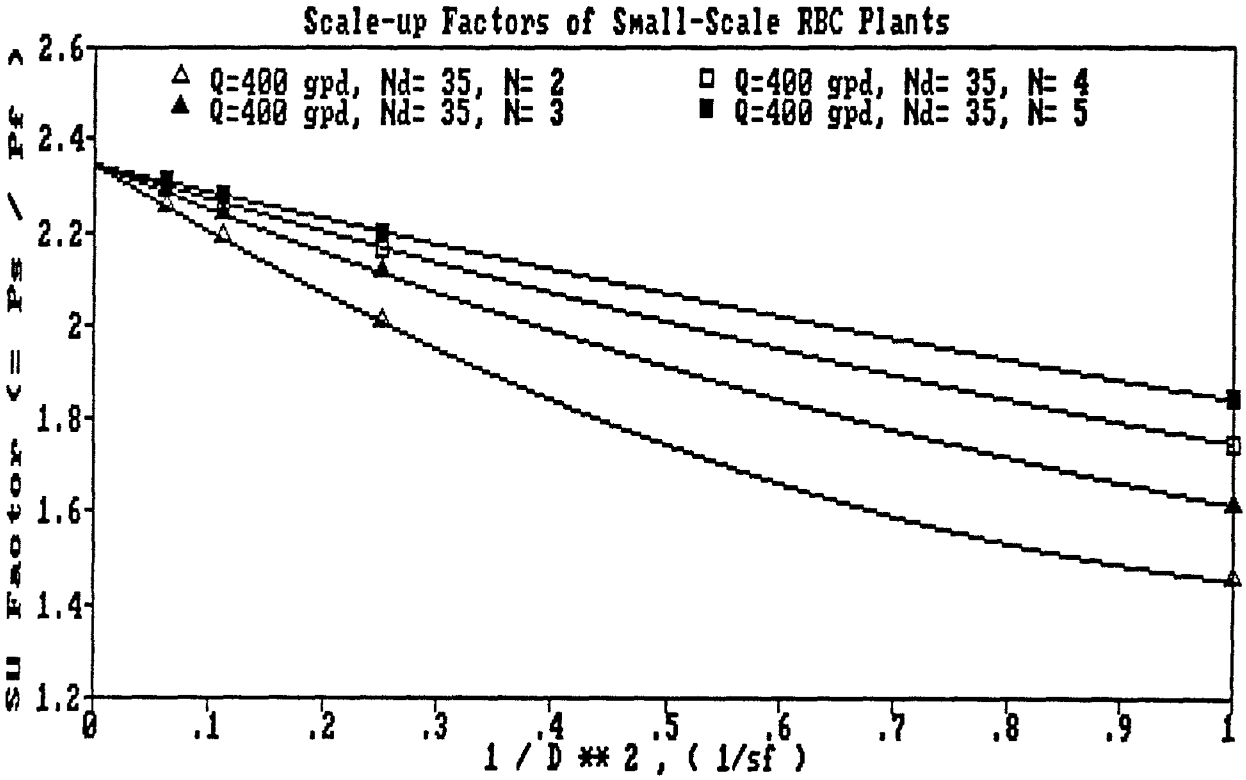

Scale-up Factors of Small-Scale RBC Plants
Q=400 gpd, Nd= 35, N= 2
Q=400 gpd, Nd= 35, N= 3
Q=400 gpd, Nd= 35, N= 4
Q=400 gpd, Nd= 35, N= 5
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-16

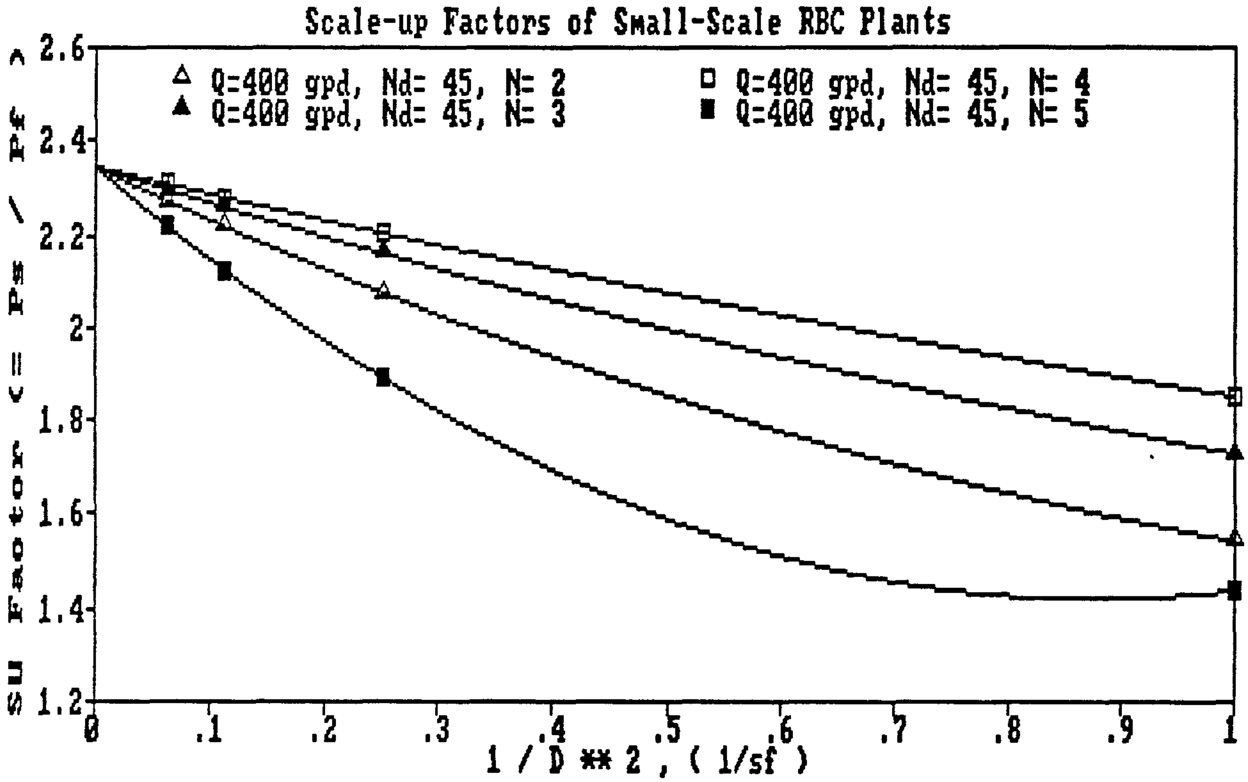
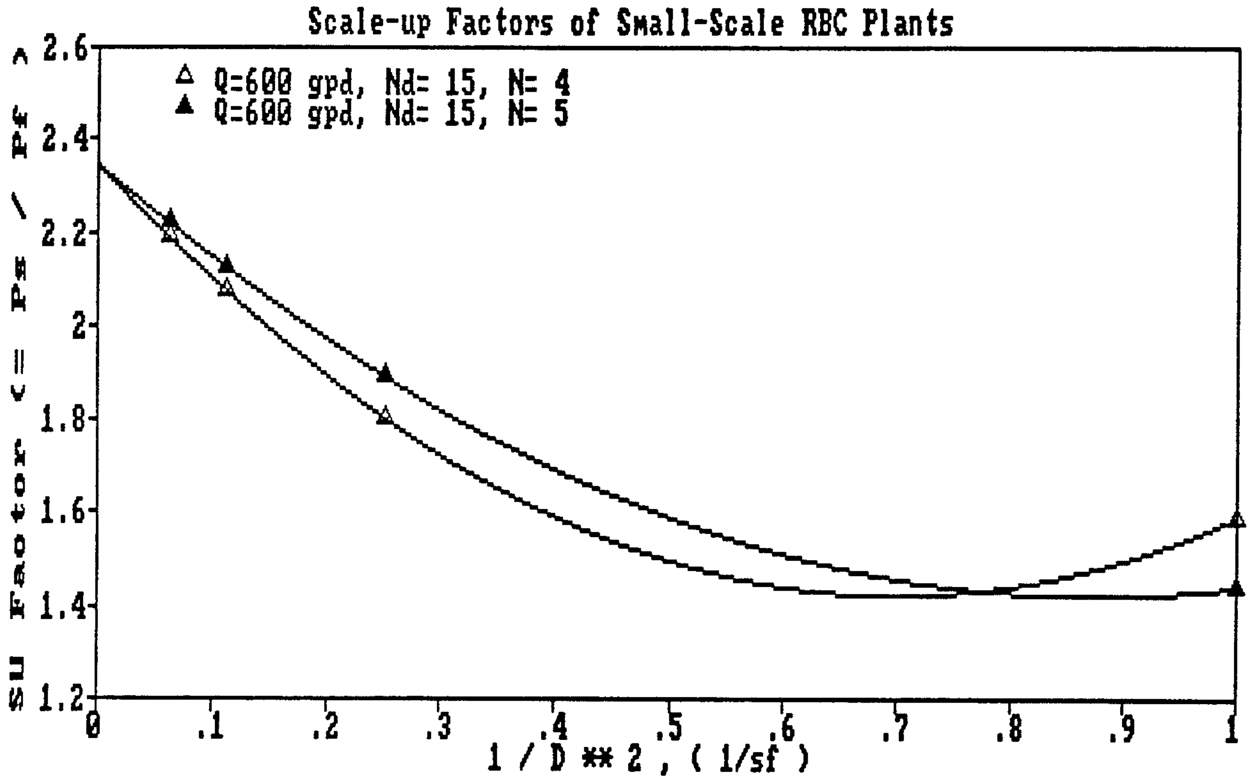
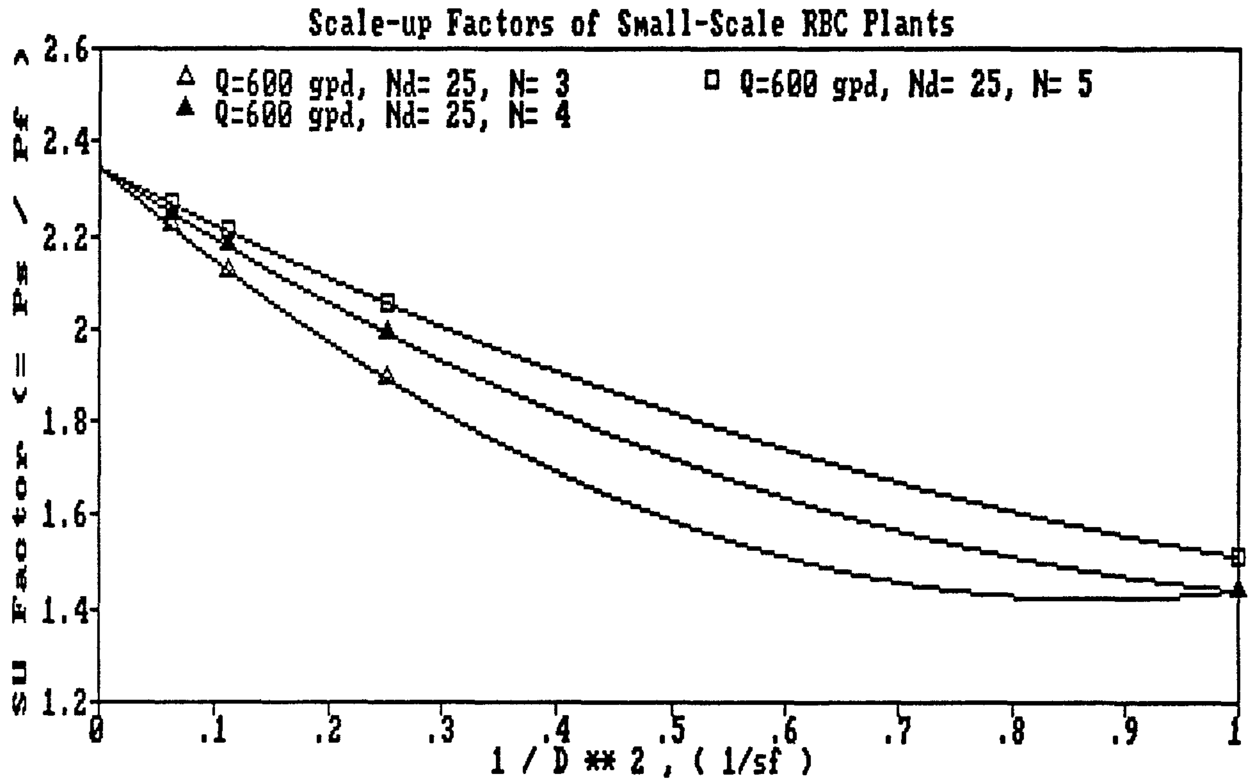

Scale-up Factors of Small-Scale RBC Plants
Q=400 gpd, Nd= 45, N= 2
Q=400 gpd, Nd= 45, N= 3
Q=400 gpd, Nd= 45, N= 4
Q=400 gpd, Nd= 45, N= 5
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-17



Scale-up Factors of Small-Scale RBC Plants
Q=600 gpd, Nd= 15, N= 4
Q=600 gpd, Nd= 15, N= 5
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-18



Scale-up Factors of Small-Scale RBC Plants
Q=600 gpd, Nd= 25, N= 3
Q=600 gpd, Nd= 25, N= 4
Q=600 gpd, Nd= 25, N= 5
SU Factor (= Ps / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-19

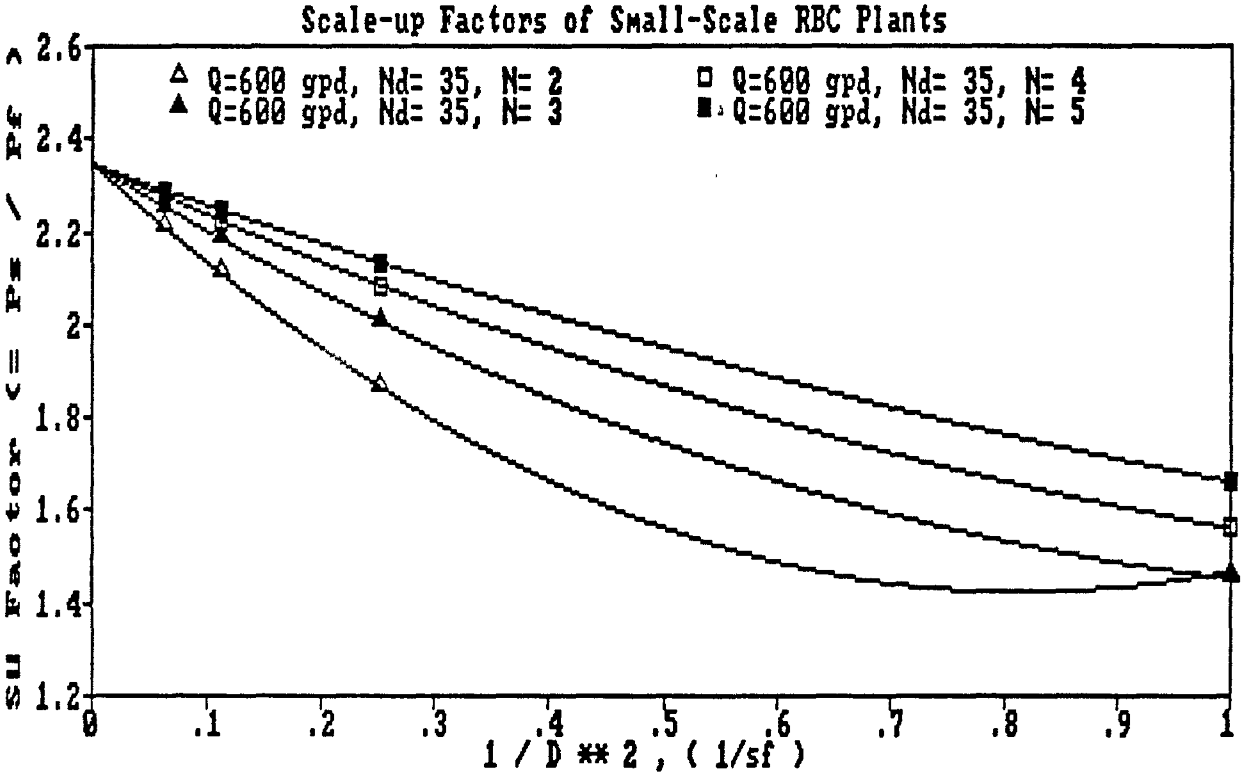
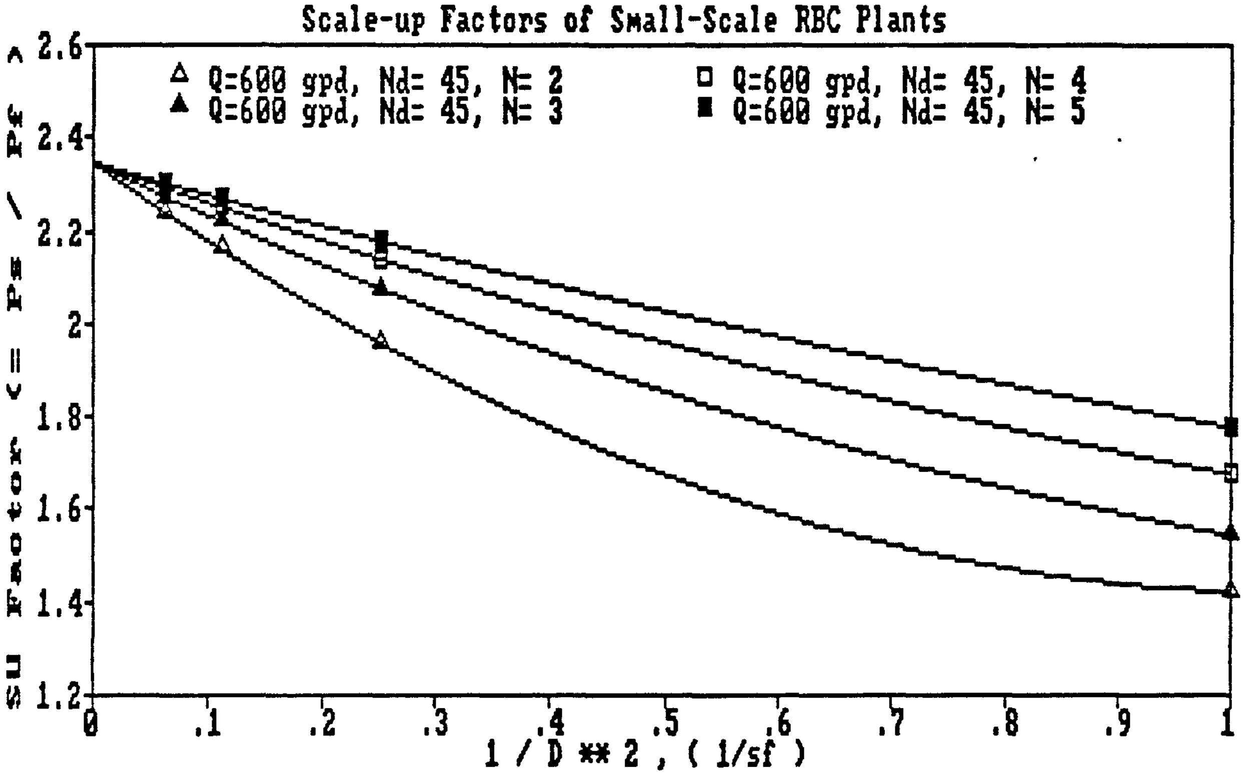
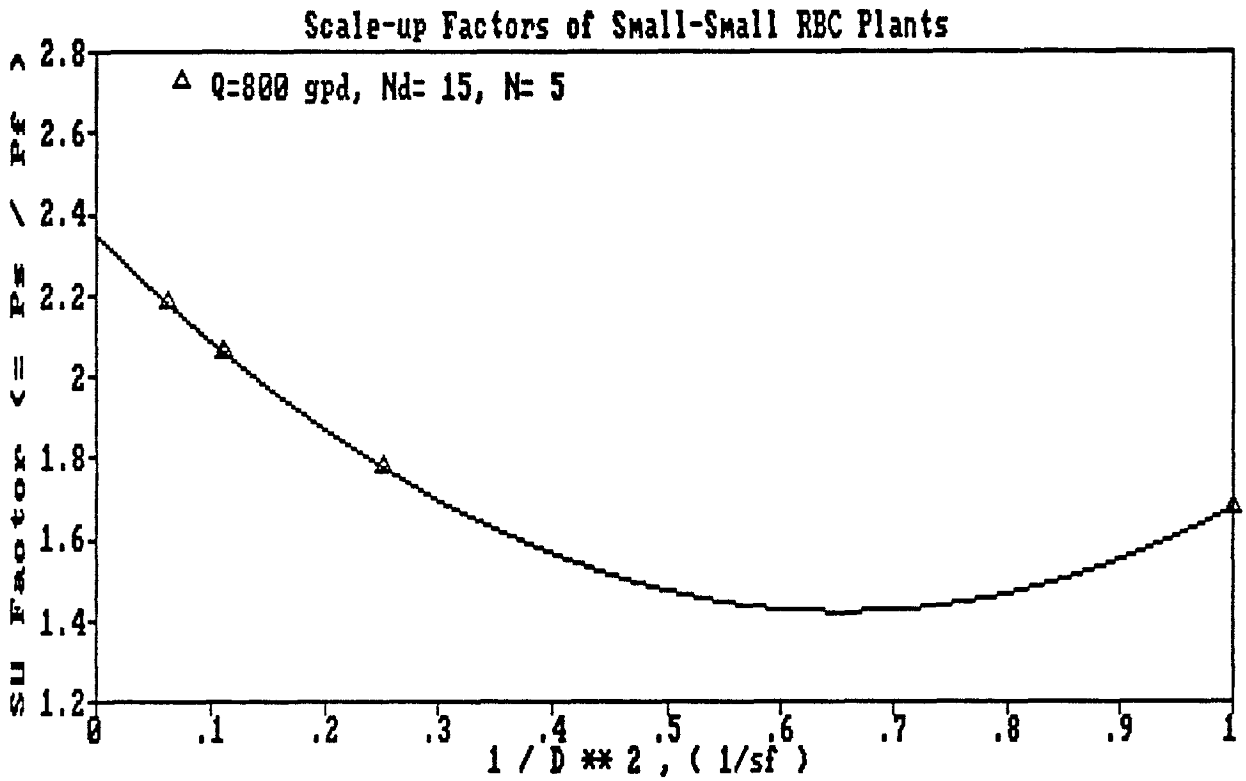

Scale-up Factors of Small-Scale RBC Plants
Q=600 gpd, Nd= 35, N= 2
Q=600 gpd, Nd= 35, N= 3
Q=600 gpd, Nd= 35, N= 4
Q=600 gpd, Nd= 35, N= 5
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-20



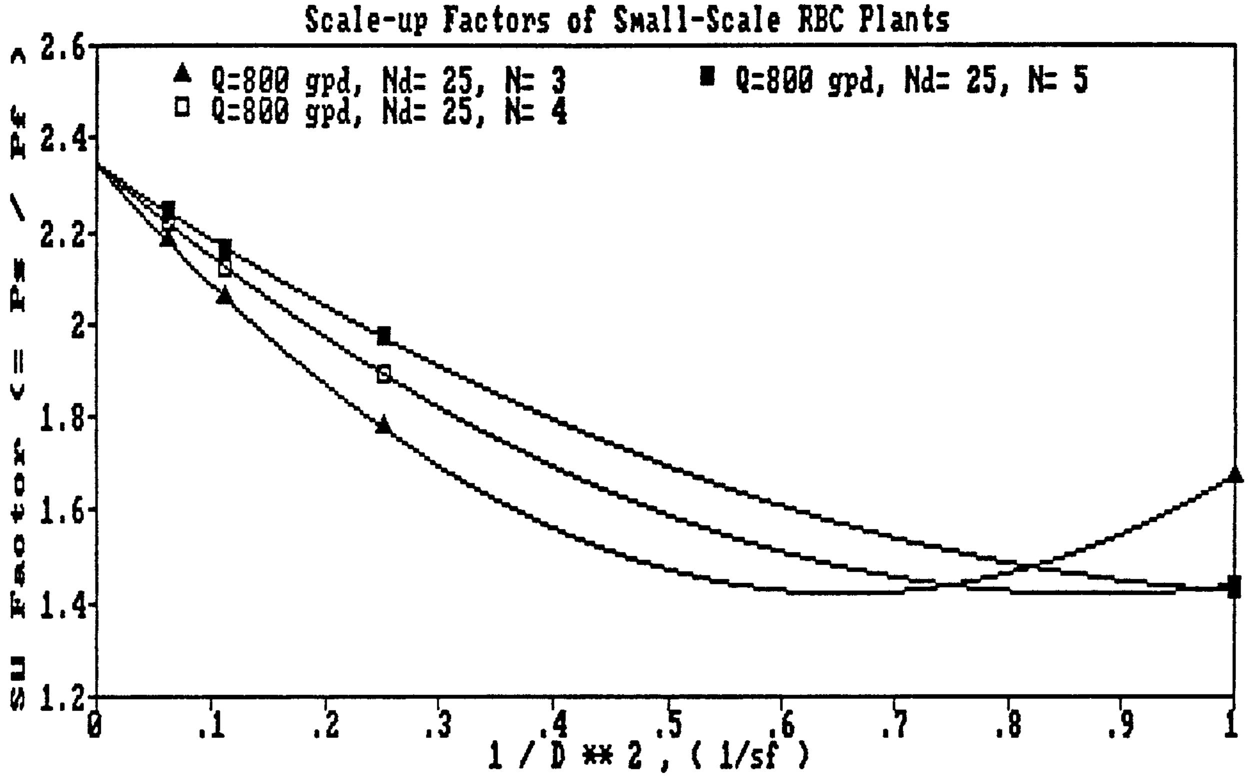
Scale-up Factors of Small-Scale RBC Plants
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
Q=600 gpd, Nd= 45, N= 2
Q=600 gpd, Nd= 45, N= 3
Q=600 gpd, Nd= 45, N= 4
Q=600 gpd, Nd= 45, N= 5
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-21



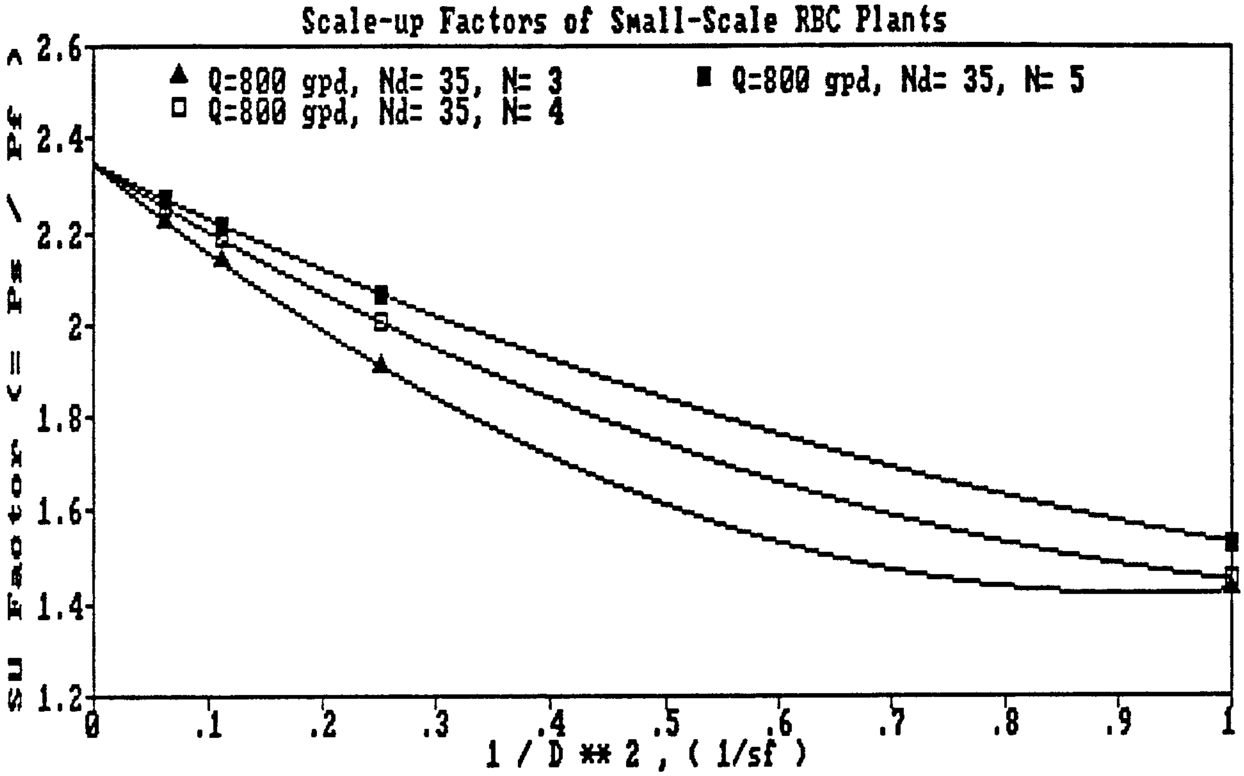
Scale-up Factors of Small-Small RBC Plants
Q=800 gpd, Nd= 15, N= 5
SU Factor <= Ps / Pf >
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-22



Scale-up Factors of Small-Scale RBC Plants
Q=800 gpd, Nd= 25, N= 3
Q=800 gpd, Nd= 25, N= 4
Q=800 gpd, Nd= 25, N= 5
SU Factor <= Pm / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-23



Scale-up Factors of Small-Scale RBC Plants
Q=800 gpd, Nd= 35, N= 3
Q=800 gpd, Nd= 35, N= 4
Q=800 gpd, Nd= 35, N= 5
SU Factor (= Ps / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-24

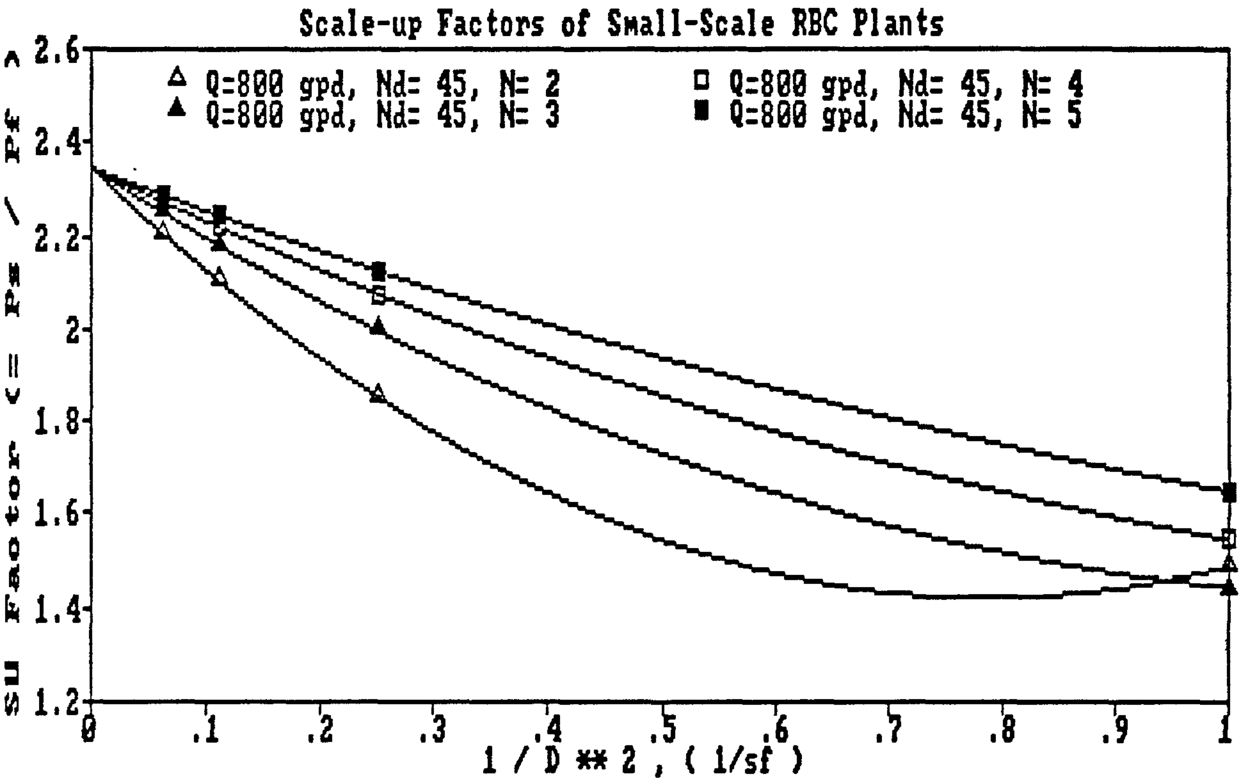

Scale-up Factors of Small-Scale RBC Plants
Q=800 gpd, Nd= 45, N= 2
Q=800 gpd, Nd= 45, N= 3
Q=800 gpd, Nd= 45, N= 4
Q=800 gpd, Nd= 45, N= 5
SU Factor (= Ps / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-25

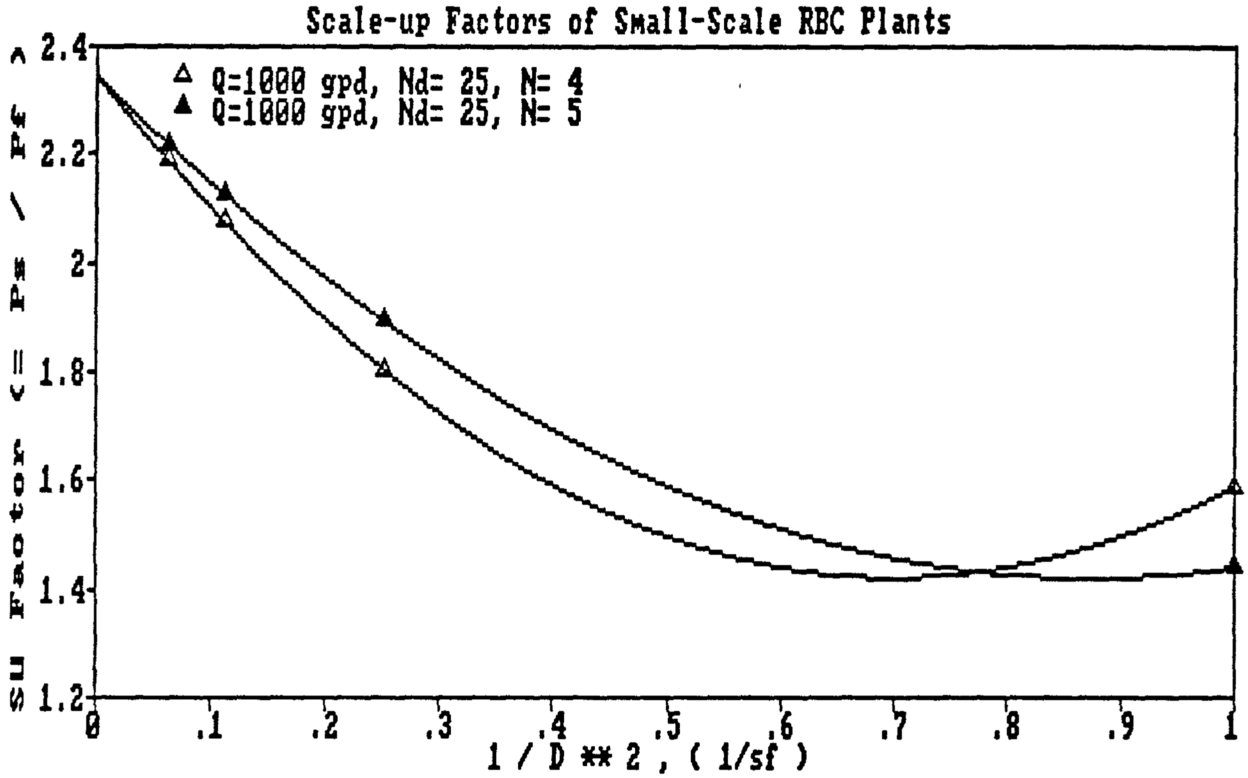
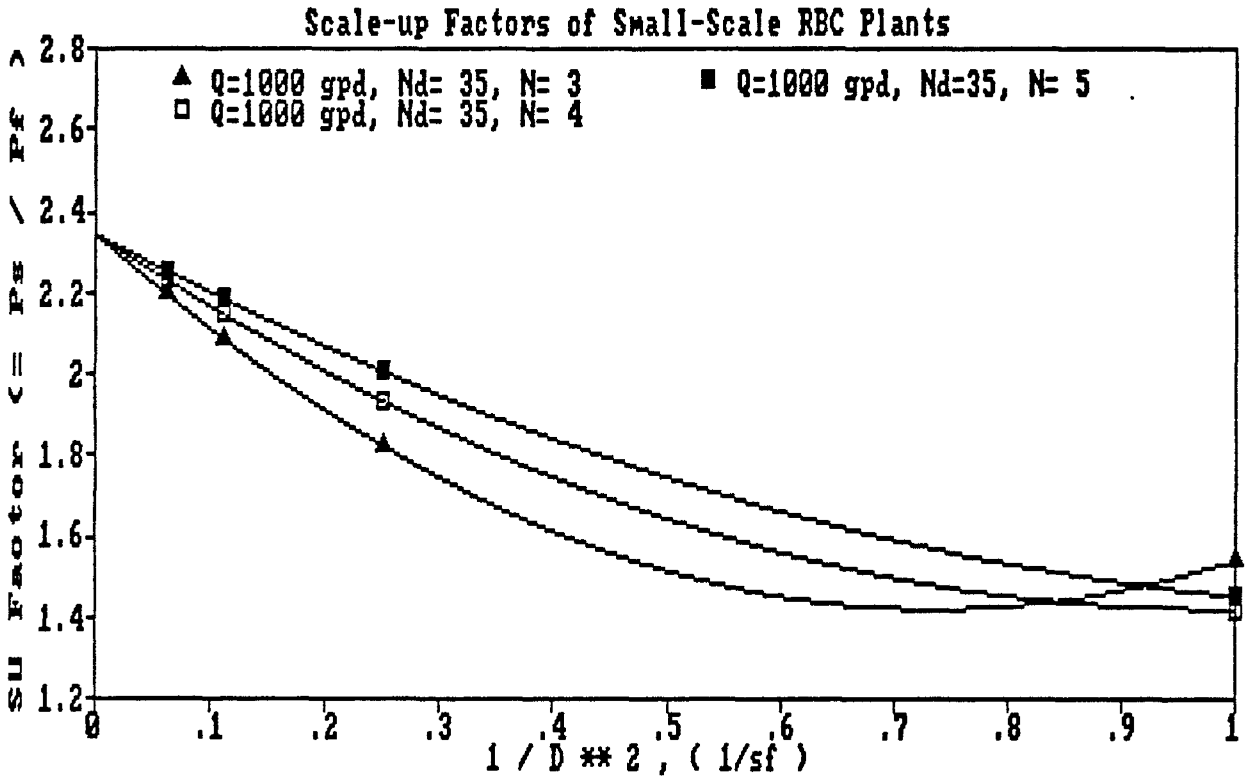
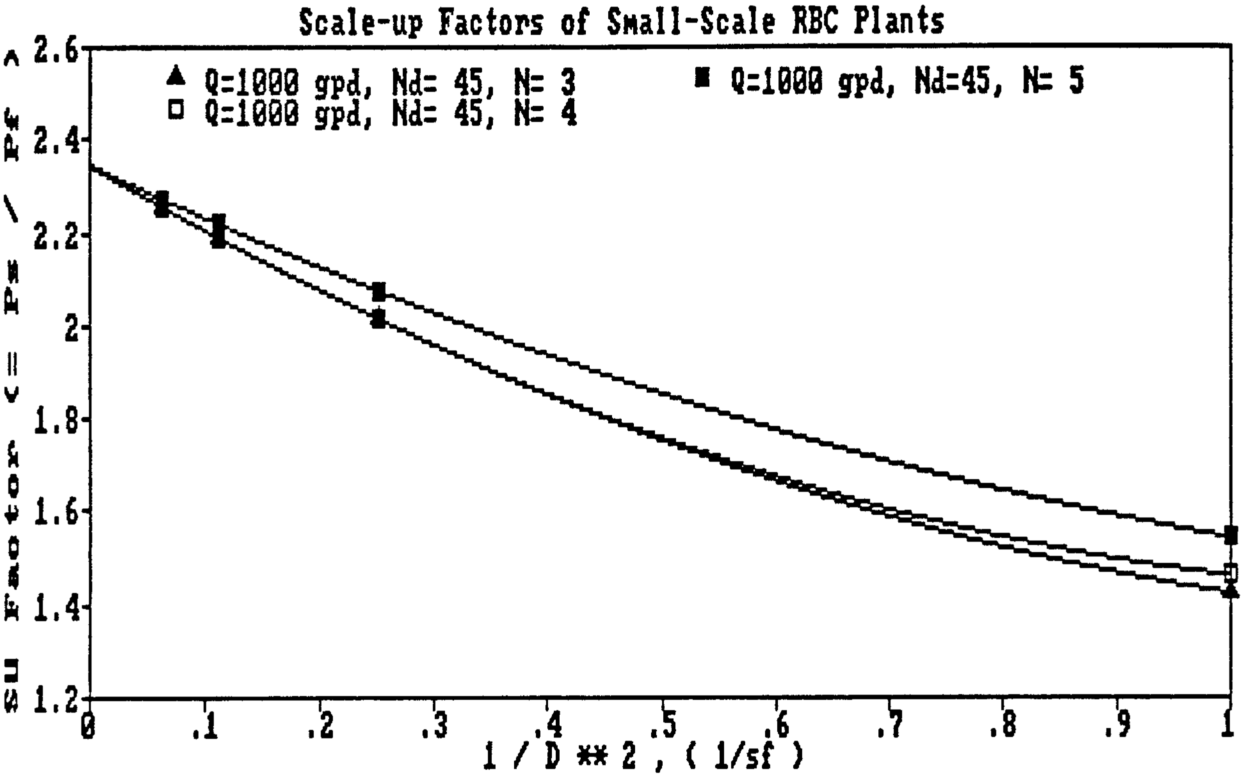

Scale-up Factors of Small-Scale RBC Plants
Q=1000 gpd, Nd= 25, N= 4
Q=1000 gpd, Nd= 25, N= 5
SU Factor (= Ps / Pf)
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-26



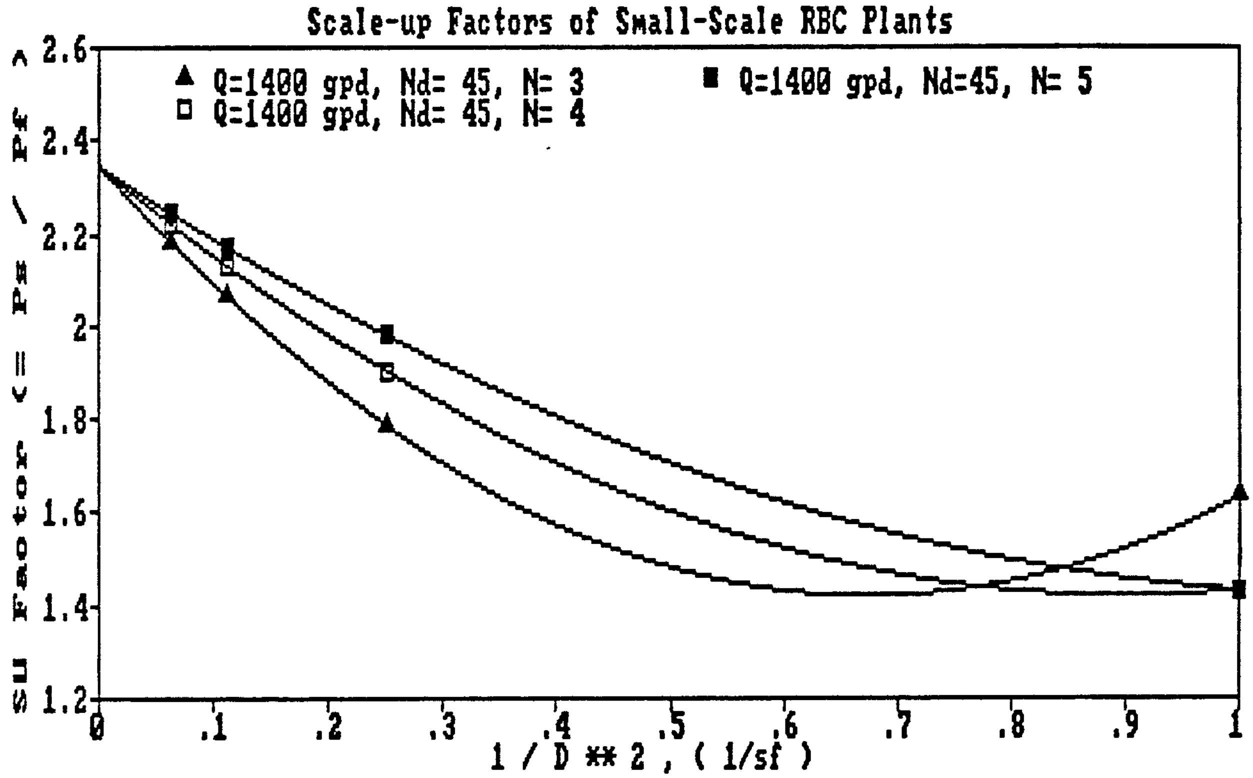
Scale-up Factors of Small-Scale RBC Plants
Q=1000 gpd, Nd= 35, N= 3
Q=1000 gpd, Nd=35, N= 5
Q=1000 gpd, Nd= 35, N= 4
SU Factor <= Ps / Pf >
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-27



Scale-up Factors of Small-Scale RBC Plants
Q=1000 gpd, Nd= 45, N= 3
Q=1000 gpd, Nd=45, N= 5
Q=1000 gpd, Nd= 45, N= 4
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-28



Scale-up Factors of Small-Scale RBC Plants
Q=1400 gpd, Nd= 45, N= 3
Q=1400 gpd, Nd= 45, N= 4
Q=1400 gpd, Nd=45, N= 5
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-29

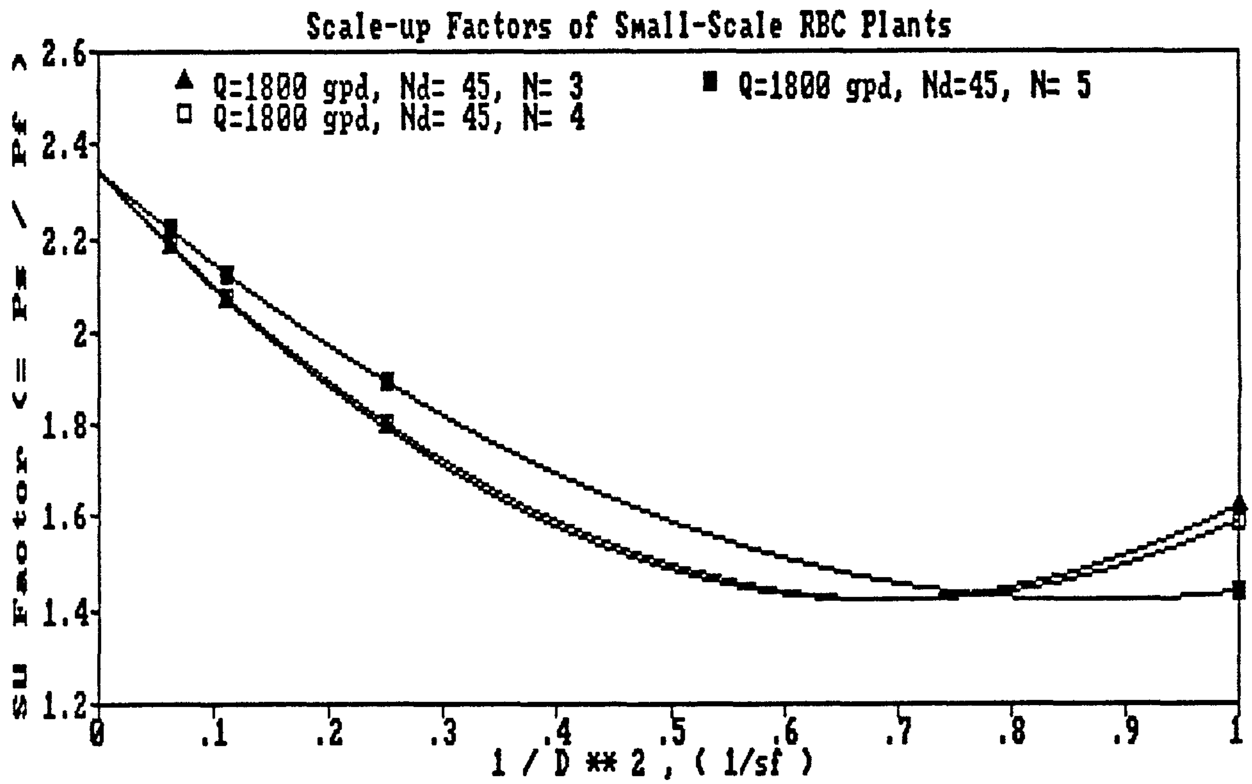

Scale-up Factors of Small-Scale RBC Plants
Q=1800 gpd, Nd= 45, N= 3
Q=1800 gpd, Nd= 45, N= 4
Q=1800 gpd, Nd=45, N= 5
SU Factor (= Pm / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-30

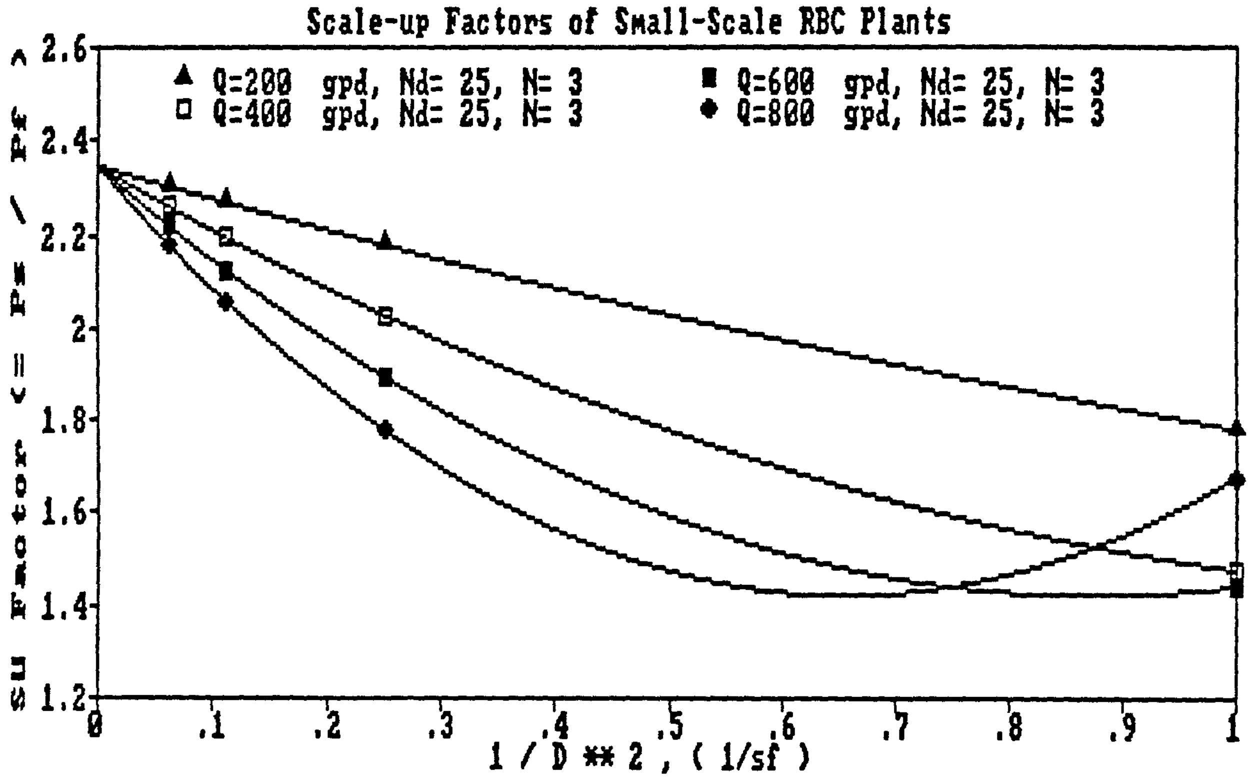

Scale-up Factors of Small-Scale RBC Plants
Q=200 gpd, Nd= 25, N= 3
Q=400 gpd, Nd= 25, N= 3
Q=600 gpd, Nd= 25, N= 3
Q=800 gpd, Nd= 25, N= 3
SU Factor (= Ps / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-31

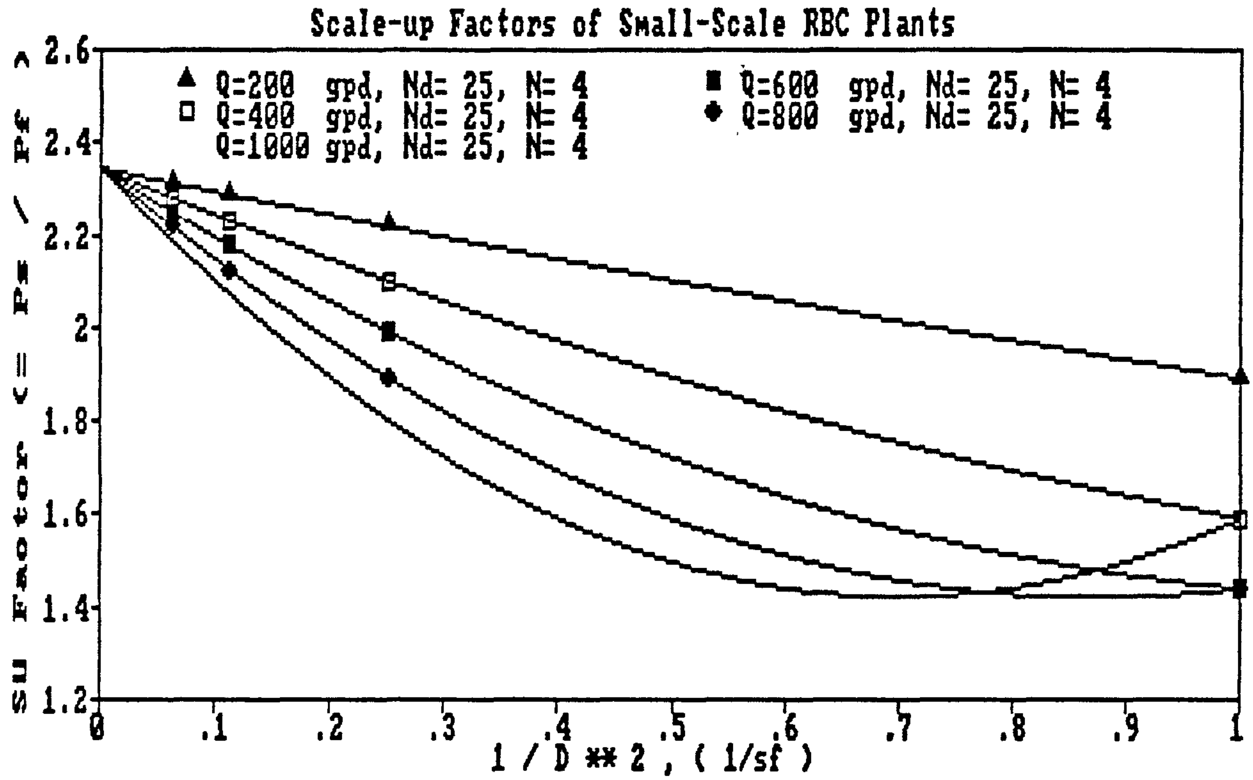
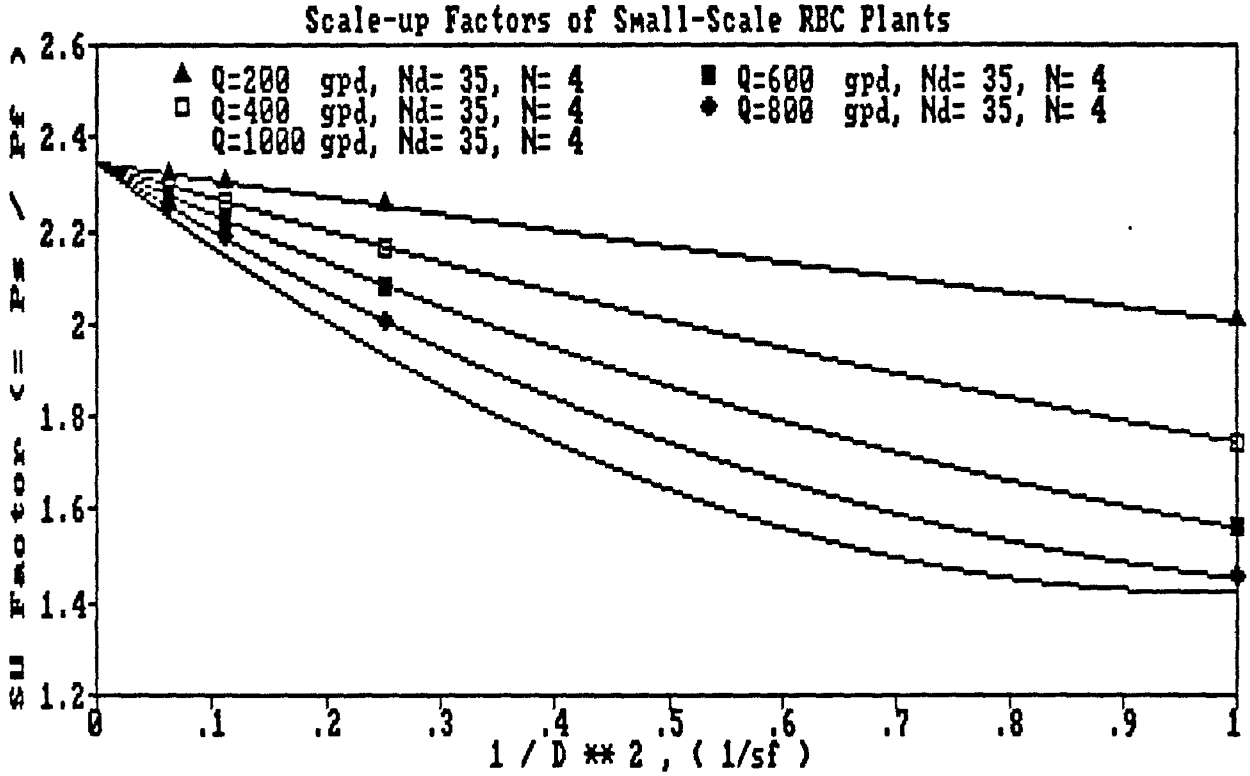

Scale-up Factors of Small-Scale RBC Plants
Q=200 gpd, Nd= 25, N= 4
Q=400 gpd, Nd= 25, N= 4
Q=1000 gpd, Nd= 25, N= 4
Q=600 gpd, Nd= 25, N= 4
Q=800 gpd, Nd= 25, N= 4
SU Factor <= Ps / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-32



Scale-up Factors of Small-Scale RBC Plants
Q=200 gpd, Nd= 35, N= 4
Q=400 gpd, Nd= 35, N= 4
Q=1000 gpd, Nd= 35, N= 4
Q=600 gpd, Nd= 35, N= 4
Q=800 gpd, Nd= 35, N= 4
SU Factor <= Pm / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-33

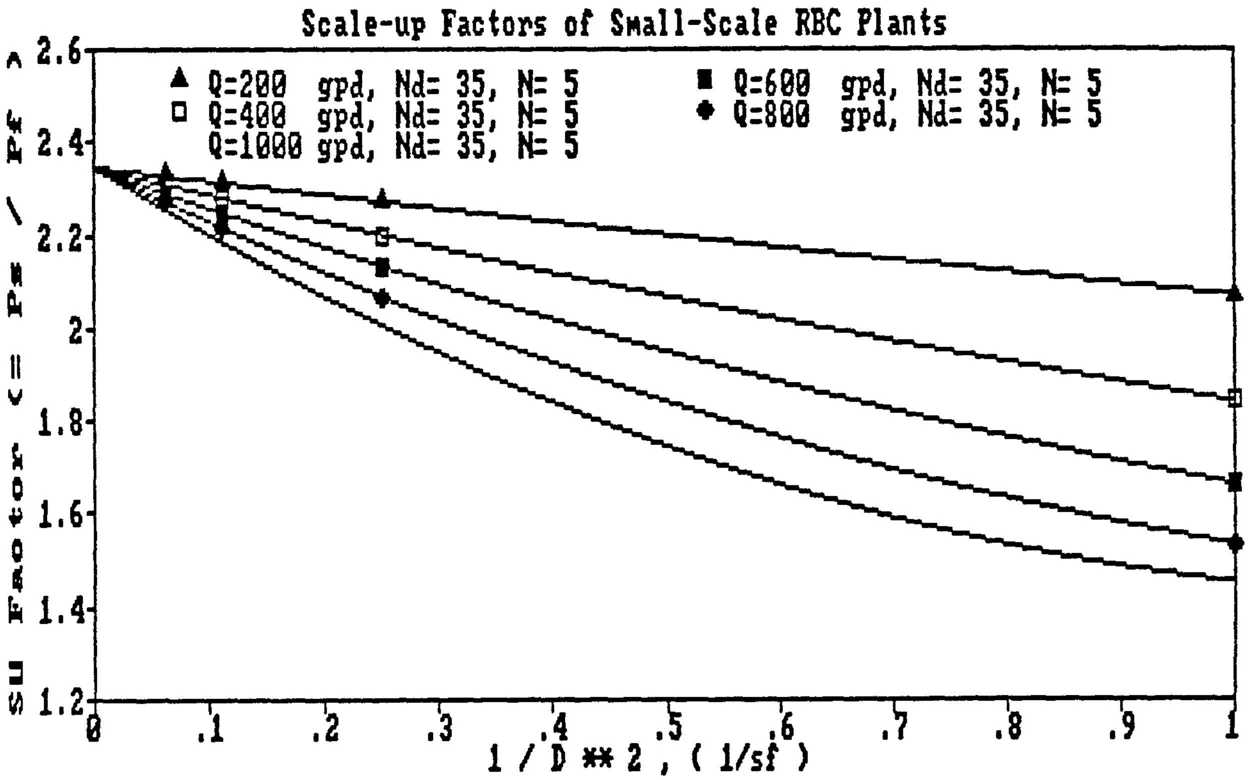

Scale-up Factors of Small-Scale RBC Plants
Q=200 gpd, Nd= 35, N= 5
Q=400 gpd, Nd= 35, N= 5
Q=1000 gpd, Nd= 35, N= 5
Q=600 gpd, Nd= 35, N= 5
Q=800 gpd, Nd= 35, N= 5
SU Factor (= Ps / Pf)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-34

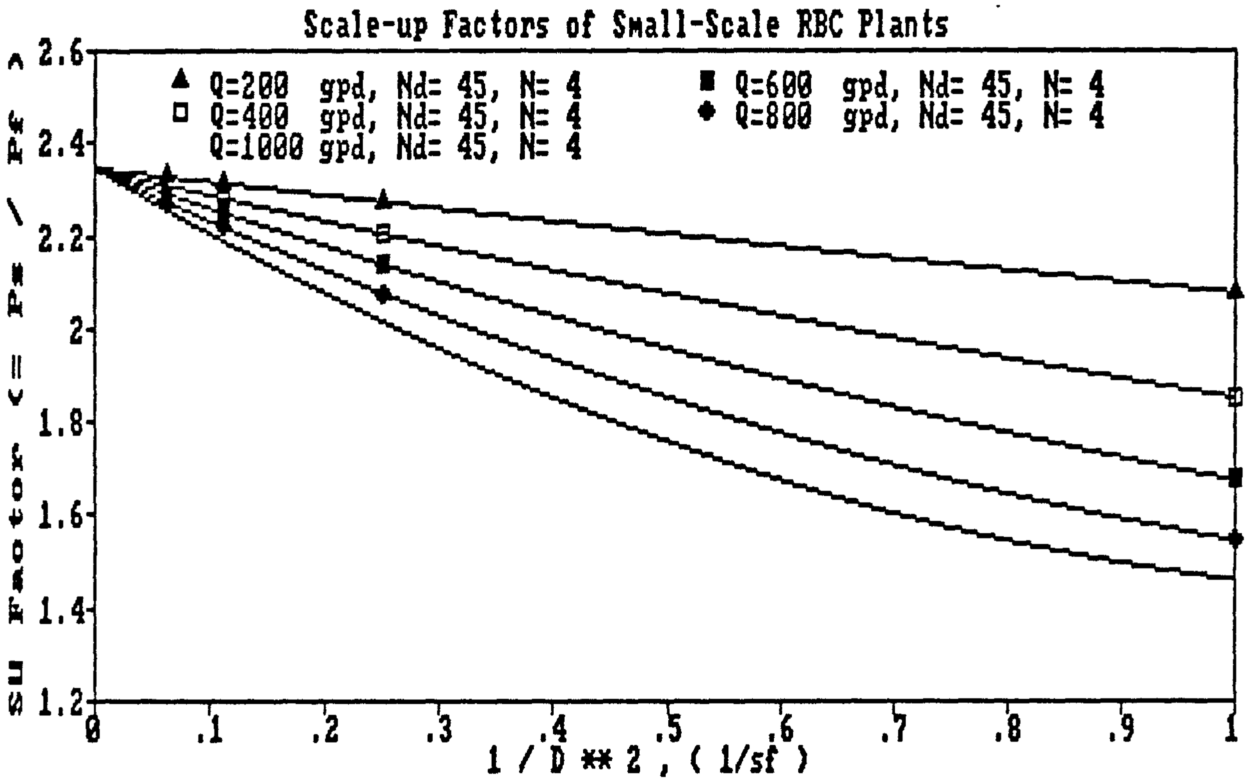
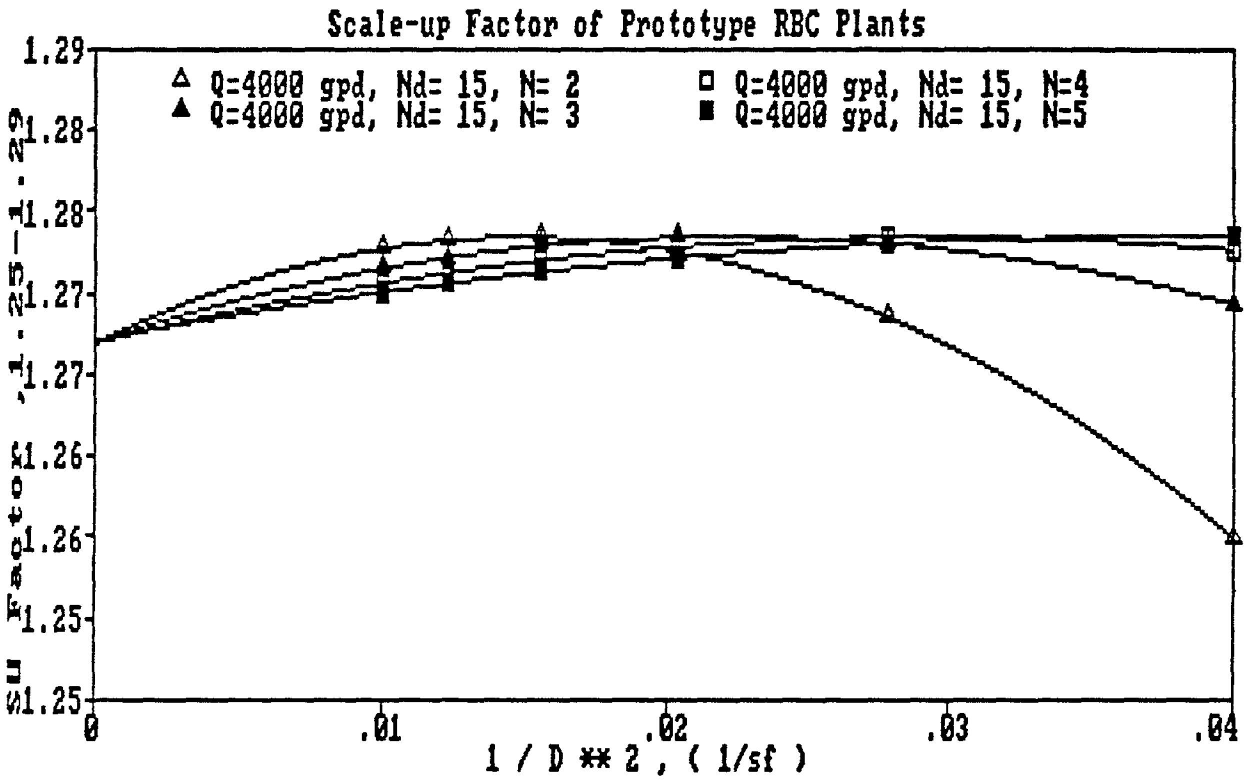

Scale-up Factors of Small-Scale RBC Plants
Q=200 gpd, Nd= 45, N= 4
Q=400 gpd, Nd= 45, N= 4
Q=1000 gpd, Nd= 45, N= 4
Q=600 gpd, Nd= 45, N= 4
Q=800 gpd, Nd= 45, N= 4
SU Factor <= Pm / Pf >
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1 / D ** 2 , (1/sf)

Figure V-35



Scale-up Factor of Prototype RBC Plants
Q=4000 gpd, Nd= 15, N= 2
Q=4000 gpd, Nd= 15, N= 3
Q=4000 gpd, Nd= 15, N=4
Q=4000 gpd, Nd= 15, N=5
1.29
1.28
1.28
1.27
1.27
1.26
1.26
1.25
1.25
SU Factor .1.25—1.29
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-36

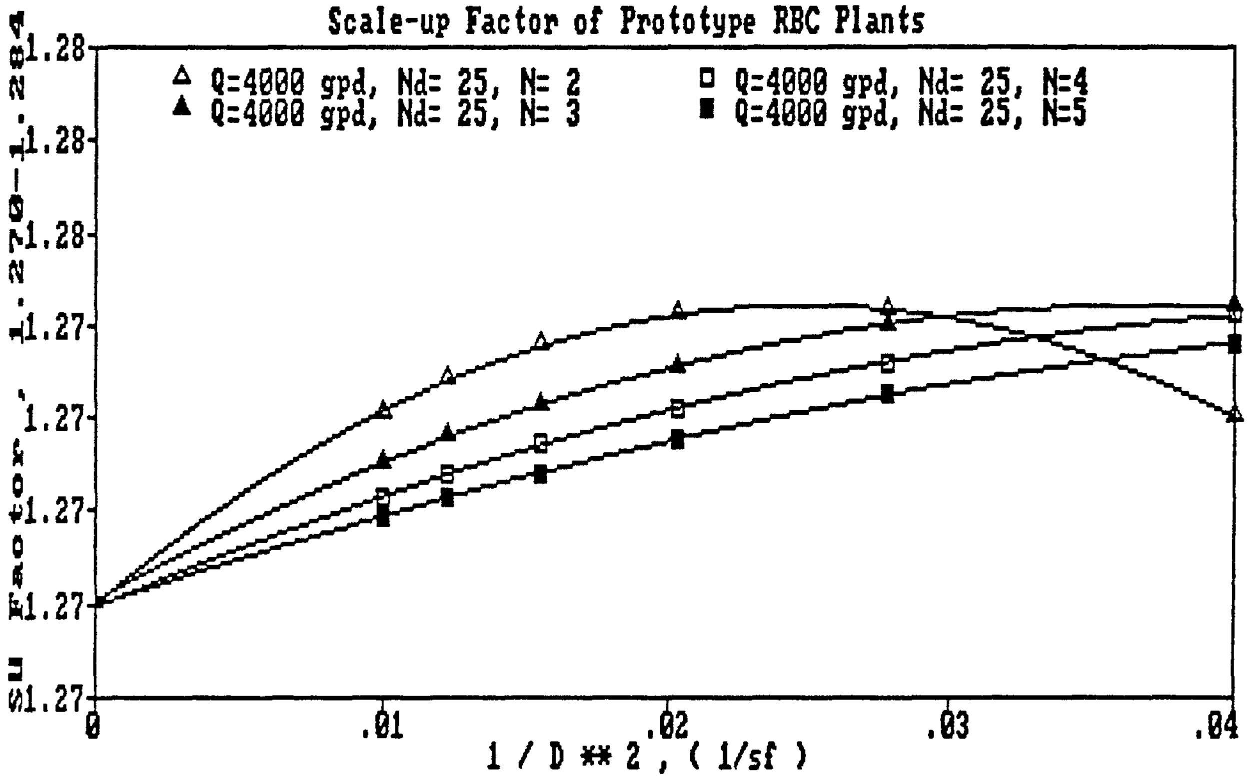
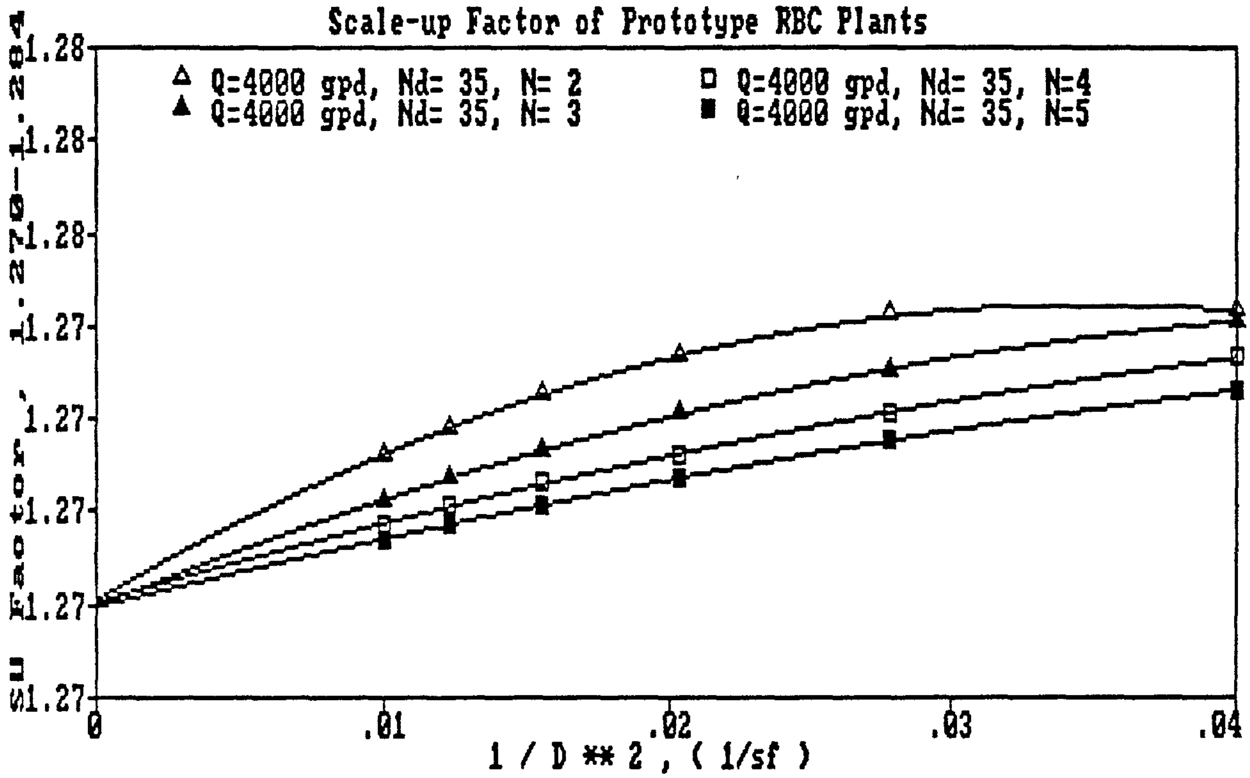

Scale-up Factor of Prototype RBC Plants
Q=4000 gpd, Nd= 25, N= 2
Q=4000 gpd, Nd= 25, N= 3
Q=4000 gpd, Nd= 25, N=4
Q=4000 gpd, Nd= 25, N=5
SU Factor, 1.270-1.284
1.28
1.28
1.28
1.27
1.27
1.27
1.27
1.27
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-37



Scale-up Factor of Prototype RBC Plants
Q=4000 gpd, Nd= 35, N= 2
Q=4000 gpd, Nd= 35, N= 3
Q=4000 gpd, Nd= 35, N=4
Q=4000 gpd, Nd= 35, N=5
SU Factor, 1.270-1.284
1.28
1.28
1.28
1.27
1.27
1.27
1.27
1.27
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-38

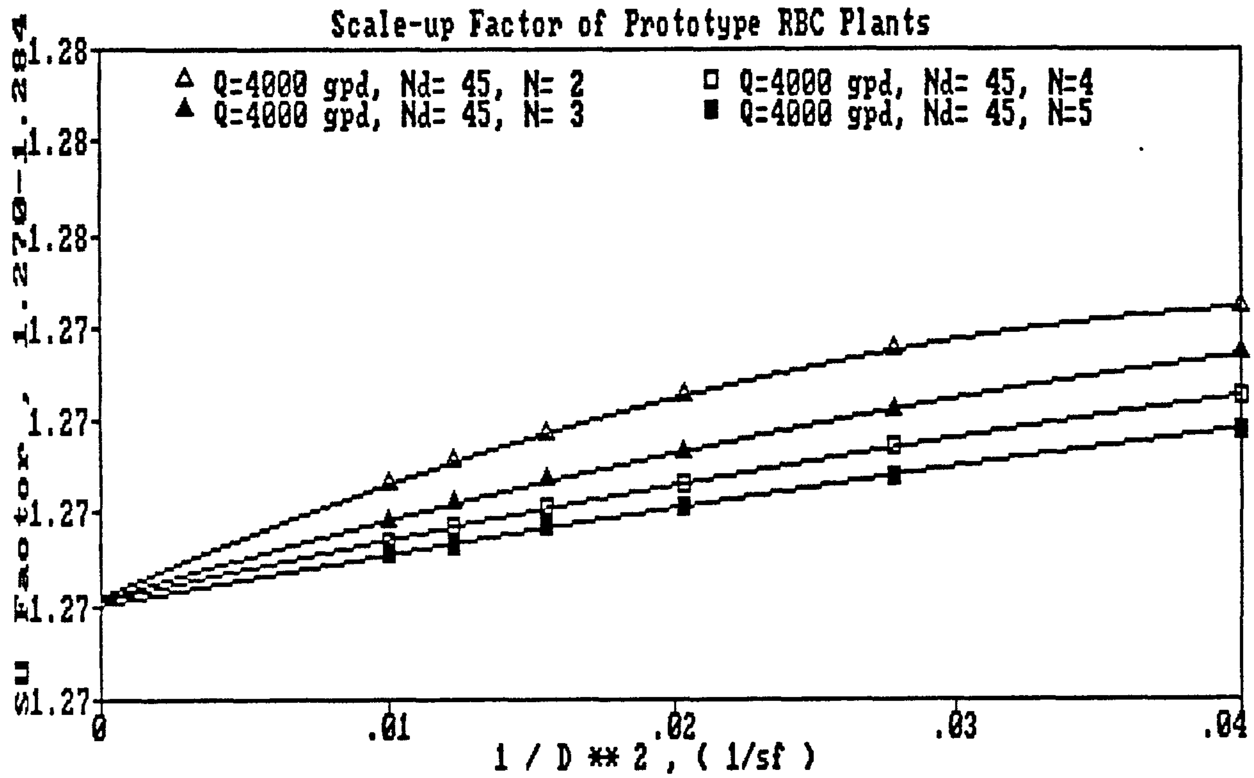

Scale-up Factor of Prototype RBC Plants
Q=4000 gpd, Nd= 45, N= 2
Q=4000 gpd, Nd= 45, N= 3
Q=4000 gpd, Nd= 45, N=4
Q=4000 gpd, Nd= 45, N=5
SU Factor, 1.270-1.284
1.28
1.28
1.28
1.27
1.27
1.27
1.27
1.27
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-39

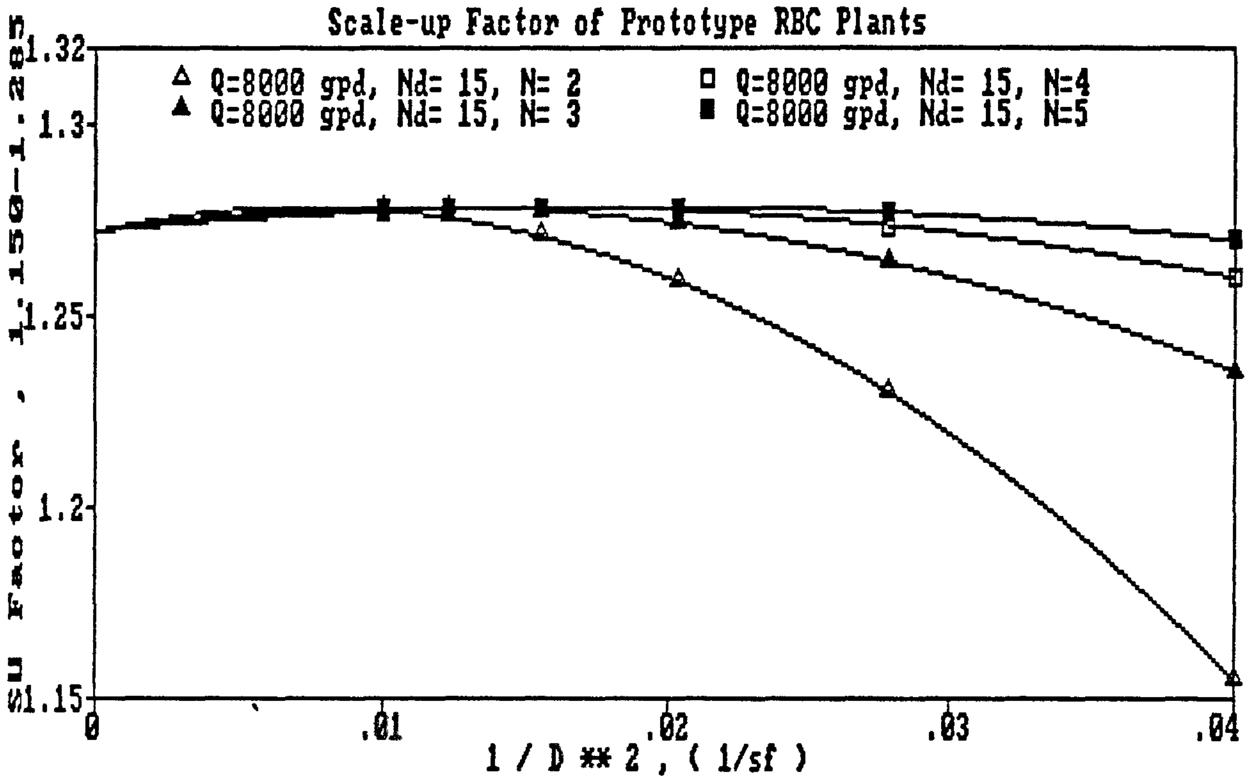

Scale-up Factor of Prototype RBC Plants
Q=8000 gpd, Nd= 15, N= 2
Q=8000 gpd, Nd= 15, N= 3
Q=8000 gpd, Nd= 15, N=4
Q=8000 gpd, Nd= 15, N=5
SU Factor , 1.150-1.285
1.32
1.3
1.25
1.2
1.15
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-40

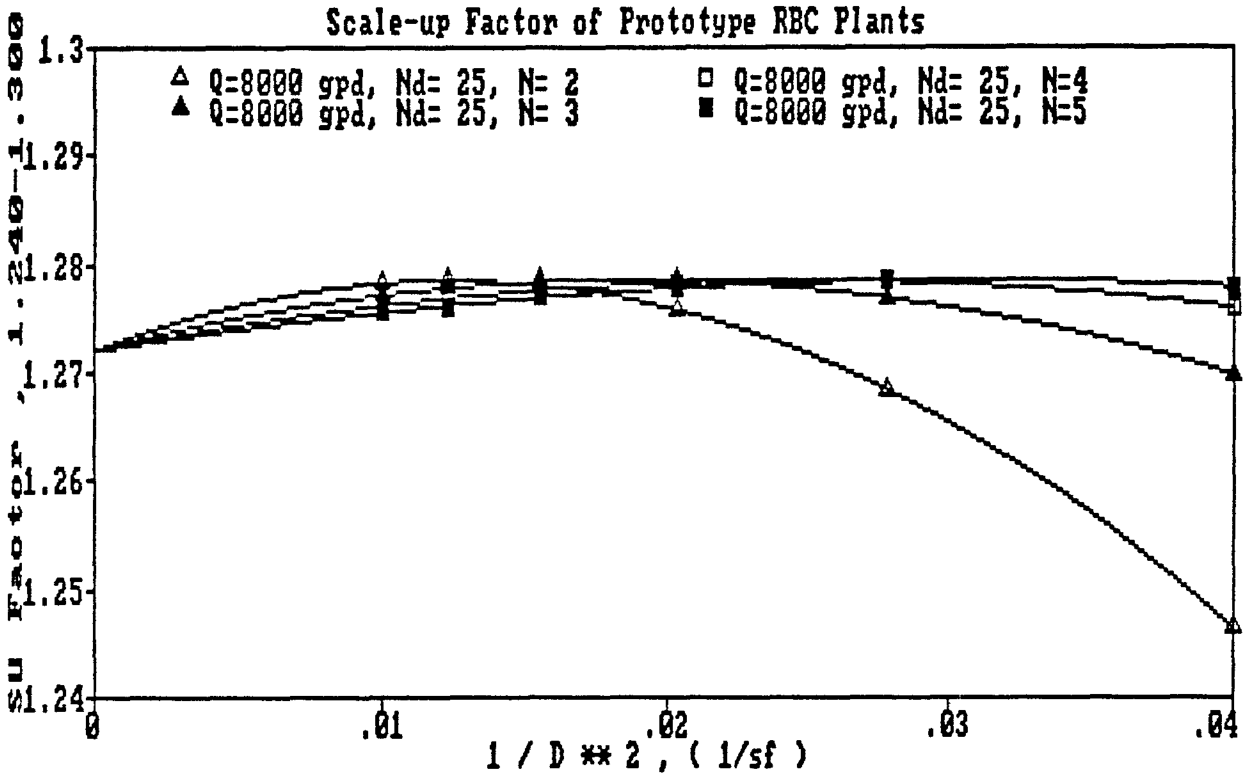

Scale-up Factor of Prototype RBC Plants
Q=8000 gpd, Nd= 25, N= 2
Q=8000 gpd, Nd= 25, N= 3
Q=8000 gpd, Nd= 25, N=4
Q=8000 gpd, Nd= 25, N=5
SU Factor , 1.240-1.300
1.3
1.29
1.28
1.27
1.26
1.25
1.24
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-41

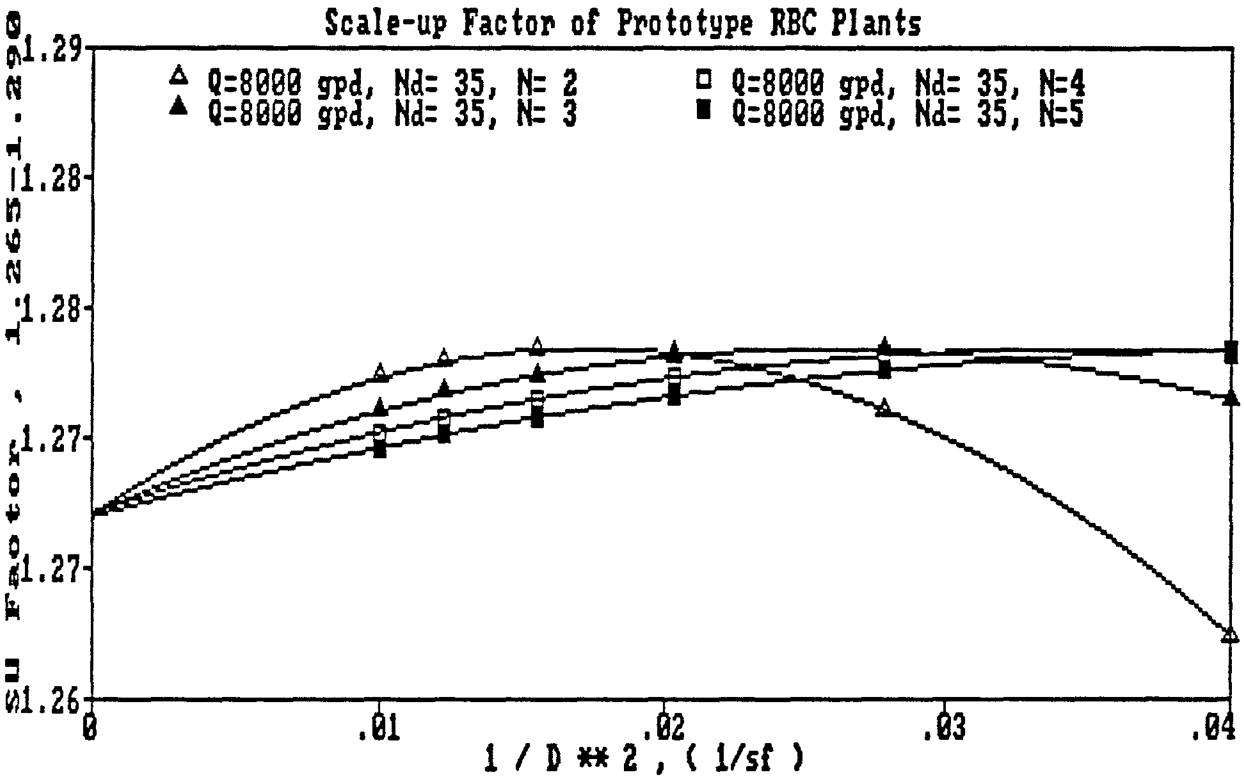

Scale-up Factor of Prototype RBC Plants
Q=8000 gpd, Nd= 35, N= 2
Q=8000 gpd, Nd= 35, N= 3
Q=8000 gpd, Nd= 35, N=4
Q=8000 gpd, Nd= 35, N=5
SU Factor , 1.265-1.290
1.29
1.28
1.28
1.27
1.27
1.26
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-42

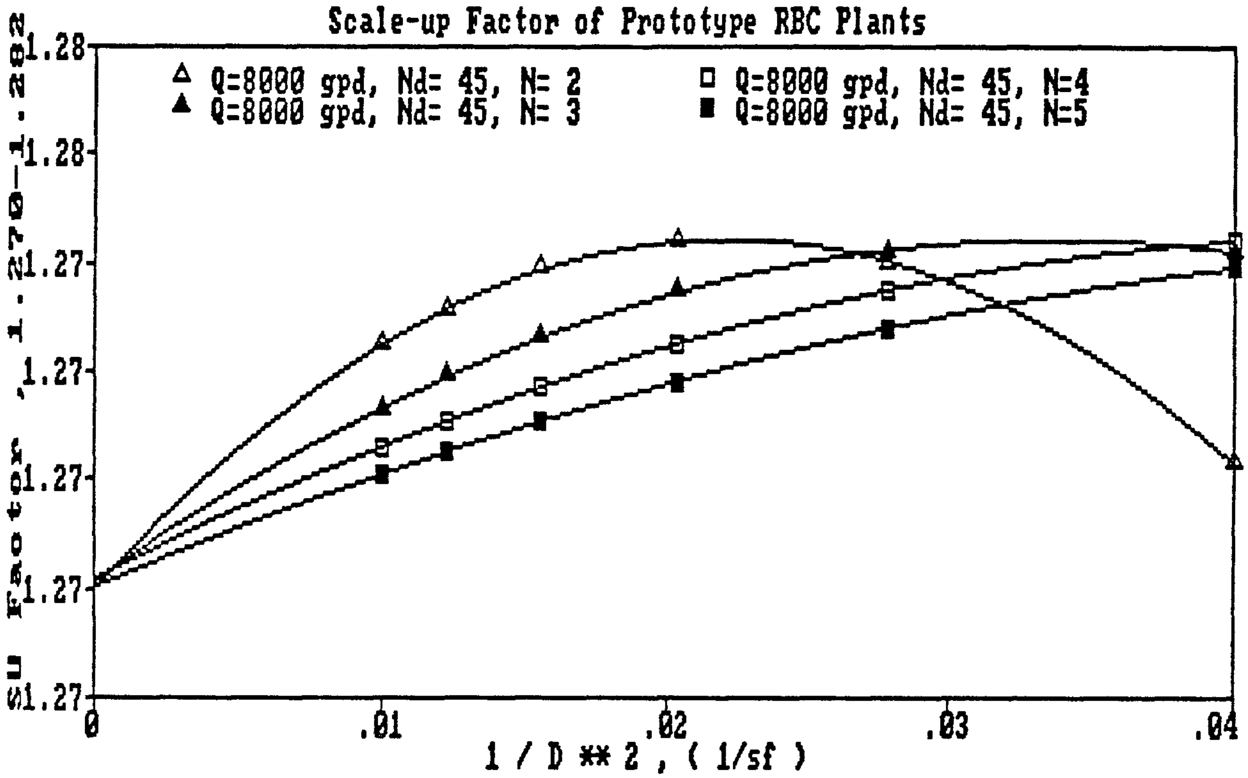

Scale-up Factor of Prototype RBC Plants
Q=8000 gpd, Nd= 45, N= 2
Q=8000 gpd, Nd= 45, N= 3
Q=8000 gpd, Nd= 45, N=4
Q=8000 gpd, Nd= 45, N=5
1.28
1.28
1.27
1.27
1.27
1.27
1.27
SU Factor ,1.270—1.282
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-43

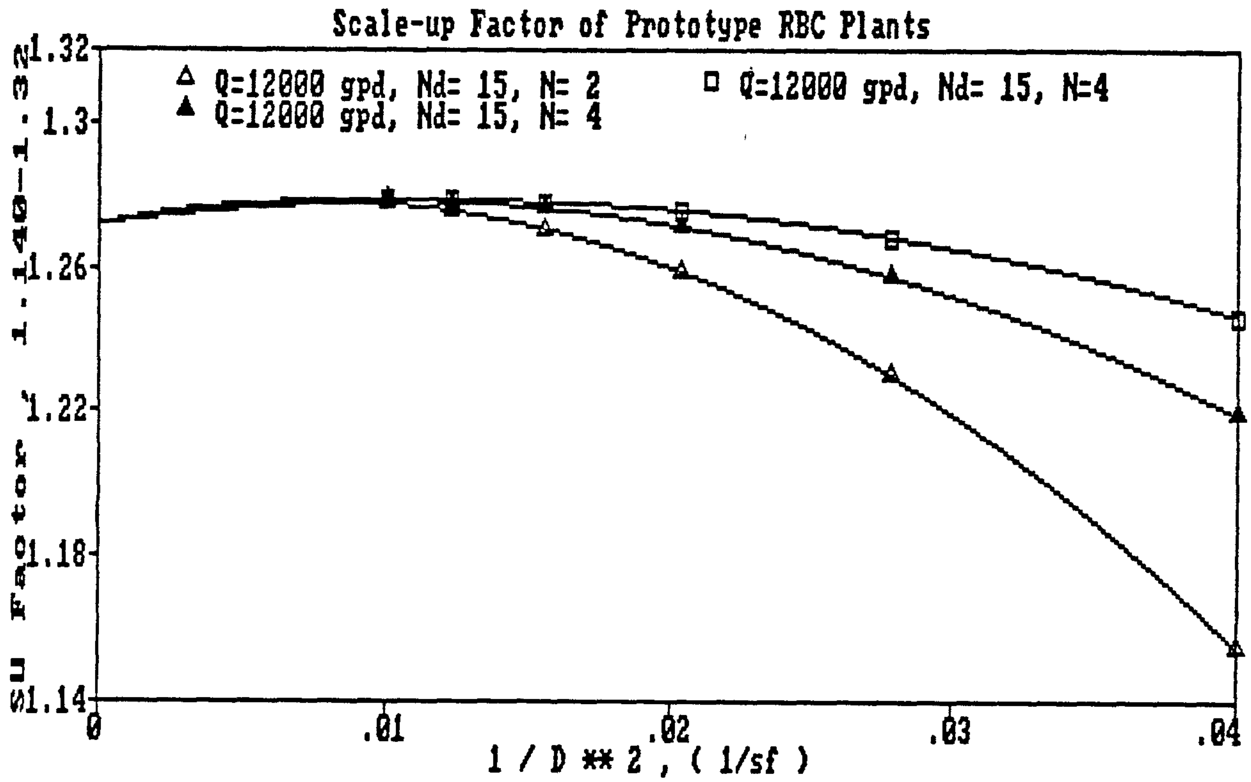

Scale-up Factor of Prototype RBC Plants
Q=12000 gpd, Nd= 15, N= 2
Q=12000 gpd, Nd= 15, N= 4
Q=12000 gpd, Nd= 15, N=4
SU Factor, 1.140-1.32
1.32
1.3
1.26
1.22
1.18
1.14
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-44

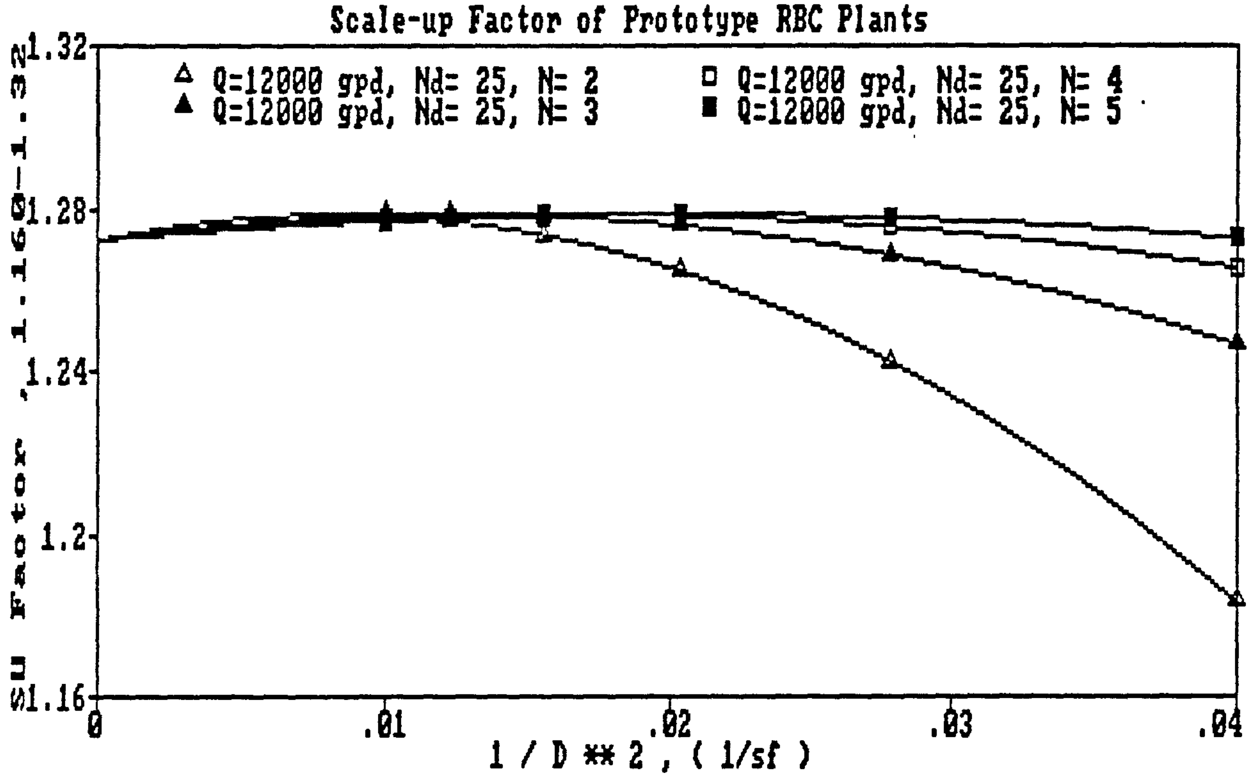

Scale-up Factor of Prototype RBC Plants
Q=12000 gpd, Nd= 25, N= 2
Q=12000 gpd, Nd= 25, N= 3
Q=12000 gpd, Nd= 25, N= 4
Q=12000 gpd, Nd= 25, N= 5
SU Factor , 1.16-1.32
1.32
1.28
1.24
1.2
1.16
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-45

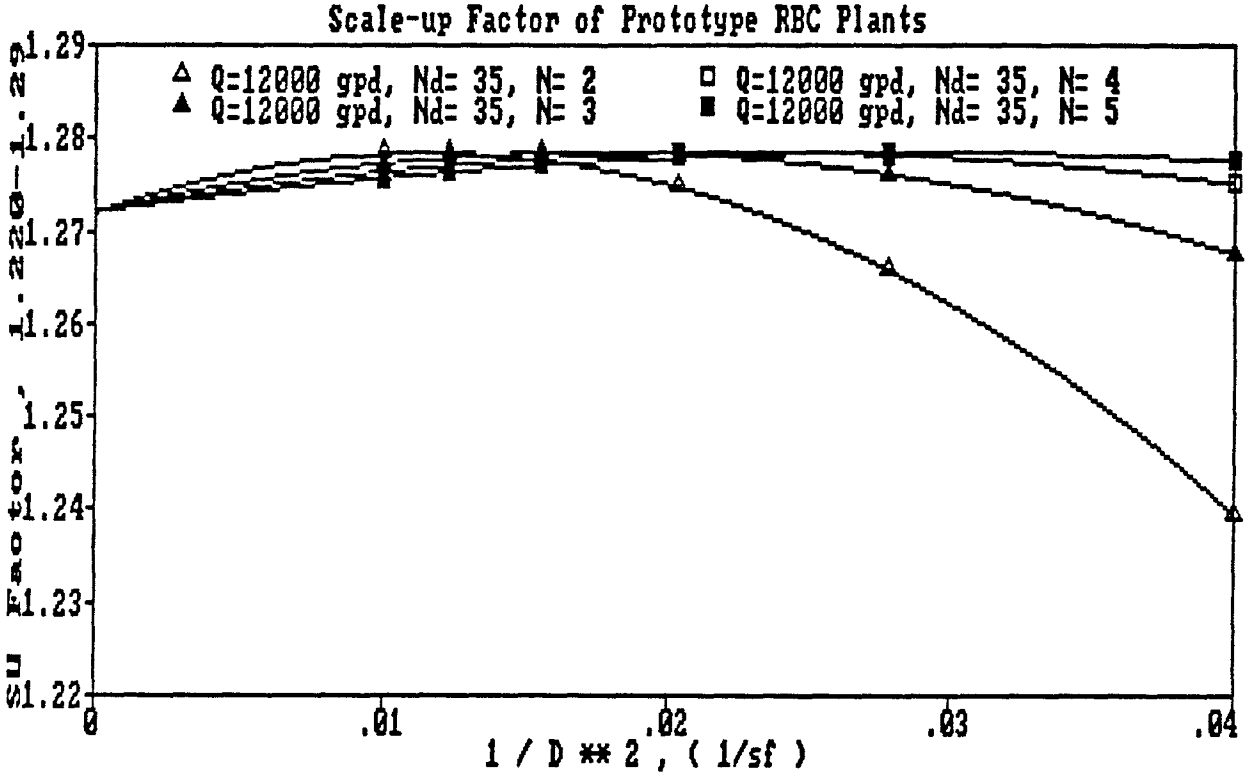
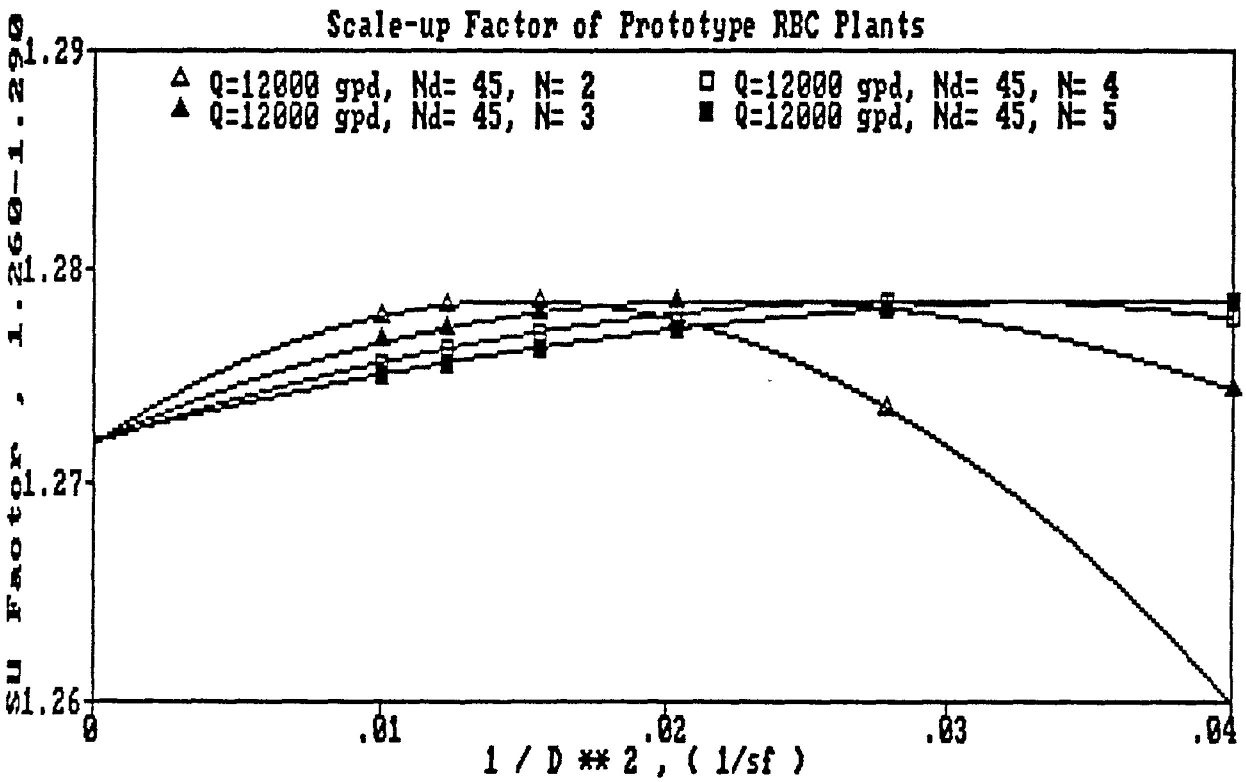
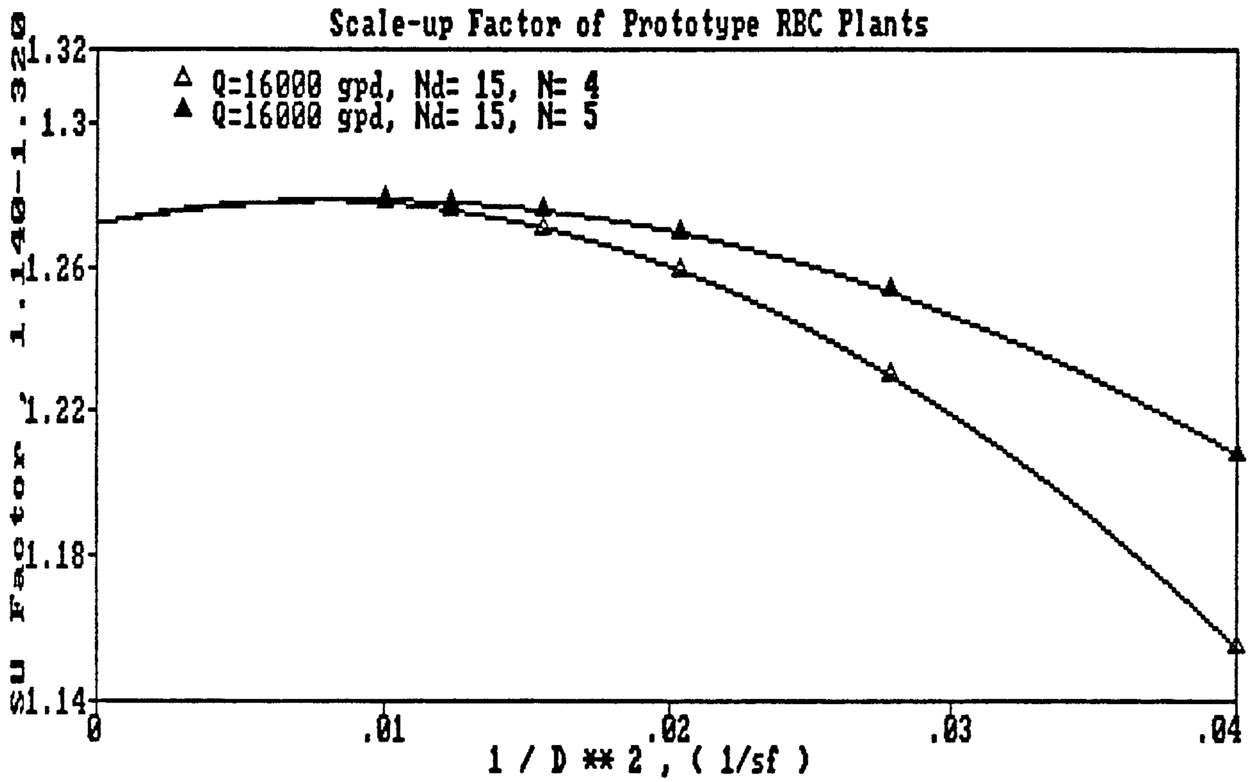

Scale-up Factor of Prototype RBC Plants
Q=12000 gpd, Nd= 35, N= 2
Q=12000 gpd, Nd= 35, N= 3
Q=12000 gpd, Nd= 35, N= 4
Q=12000 gpd, Nd= 35, N= 5
SU Factor, 1.220-1.29
1.29
1.28
1.27
1.26
1.25
1.24
1.23
1.22
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-46



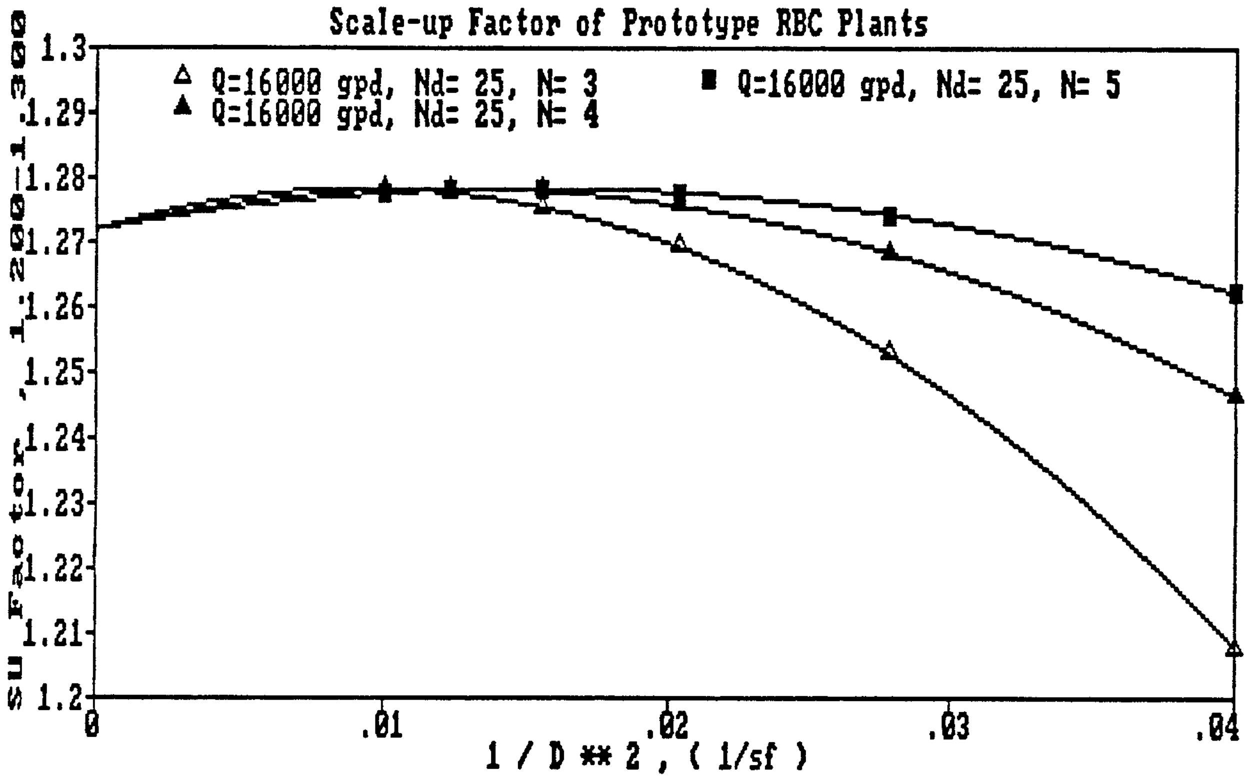
Scale-up Factor of Prototype RBC Plants
Q=12000 gpd, Nd= 45, N= 2
Q=12000 gpd, Nd= 45, N= 3
Q=12000 gpd, Nd= 45, N= 4
Q=12000 gpd, Nd= 45, N= 5
SU Factor , 1.260-1.290
1.29
1.28
1.27
1.26
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-47



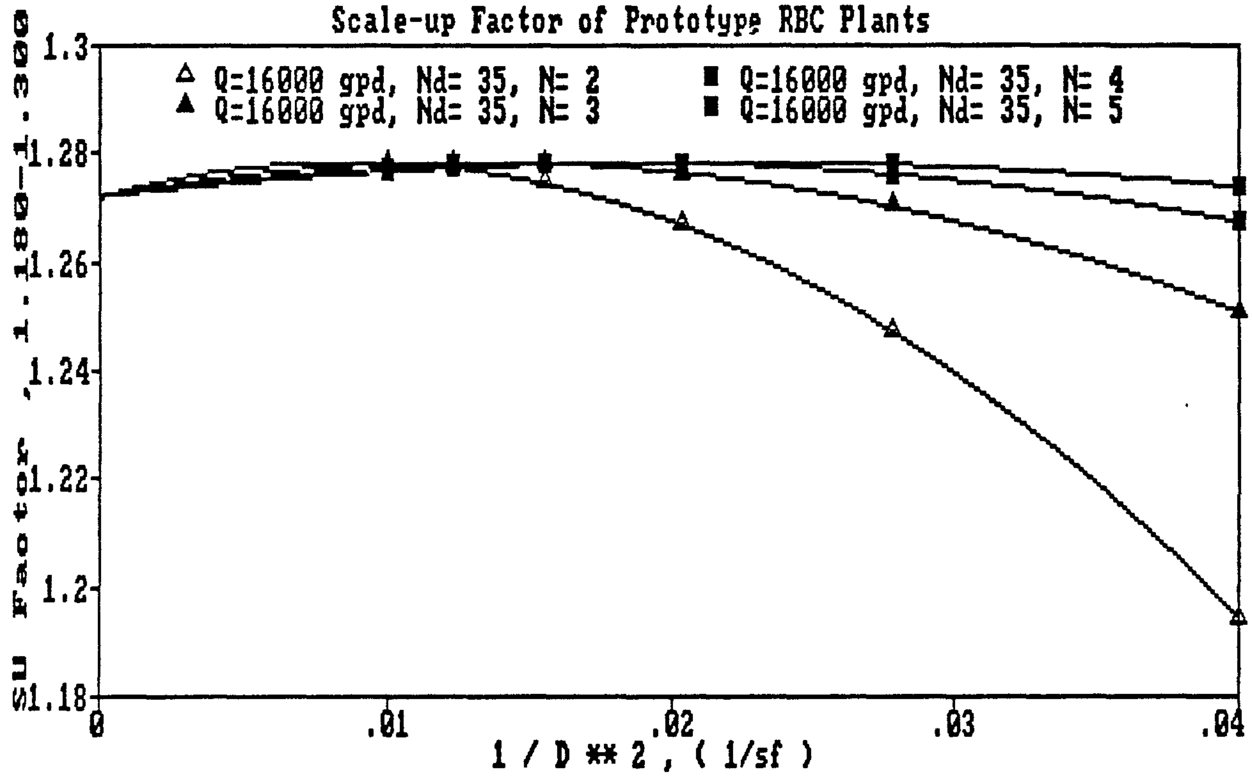
Scale-up Factor of Prototype RBC Plants
Q=16000 gpd, Nd= 15, N= 4
Q=16000 gpd, Nd= 15, N= 5
SU Factor, 1.140-1.320
1.32
1.3
1.26
1.22
1.18
1.14
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-48



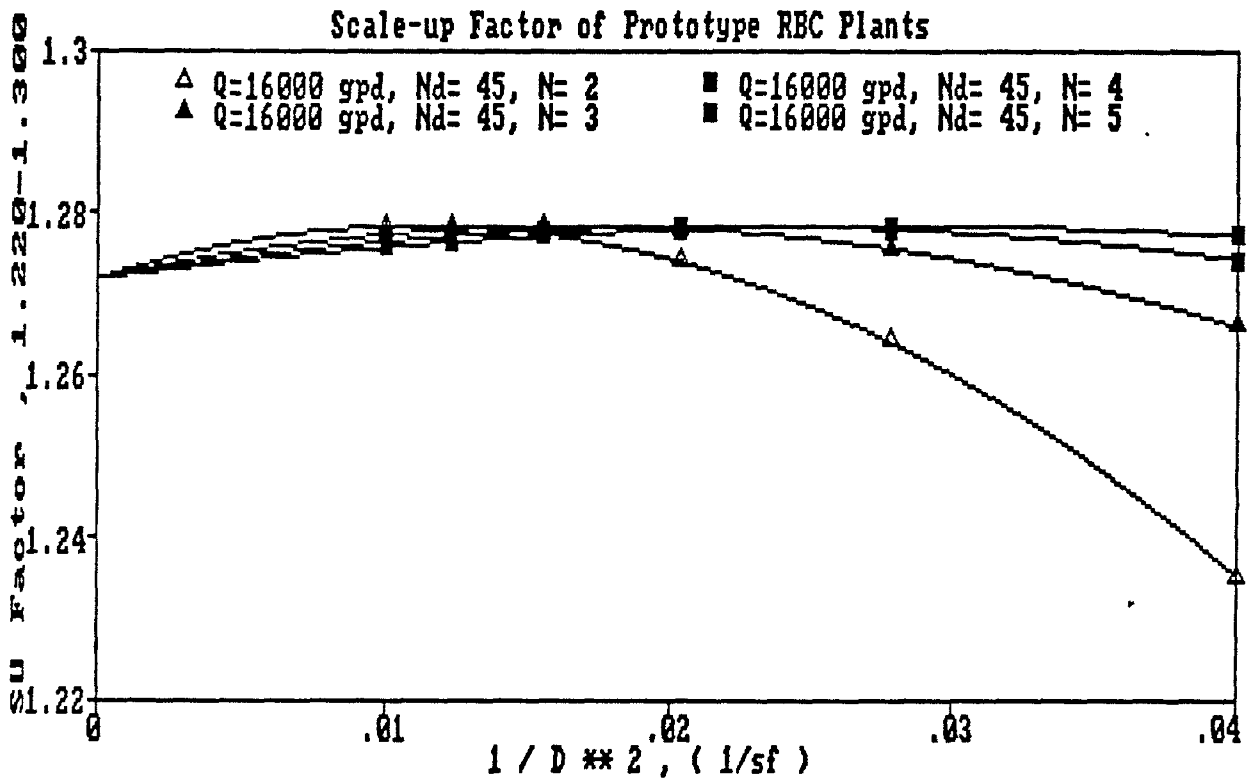
Scale-up Factor of Prototype RBC Plants
SU Factor, 1.200-1.300
1.3
1.29
1.28
1.27
1.26
1.25
1.24
1.23
1.22
1.21
1.2
Q=16000 gpd, Nd= 25, N= 3
Q=16000 gpd, Nd= 25, N= 4
Q=16000 gpd, Nd= 25, N= 5
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-49



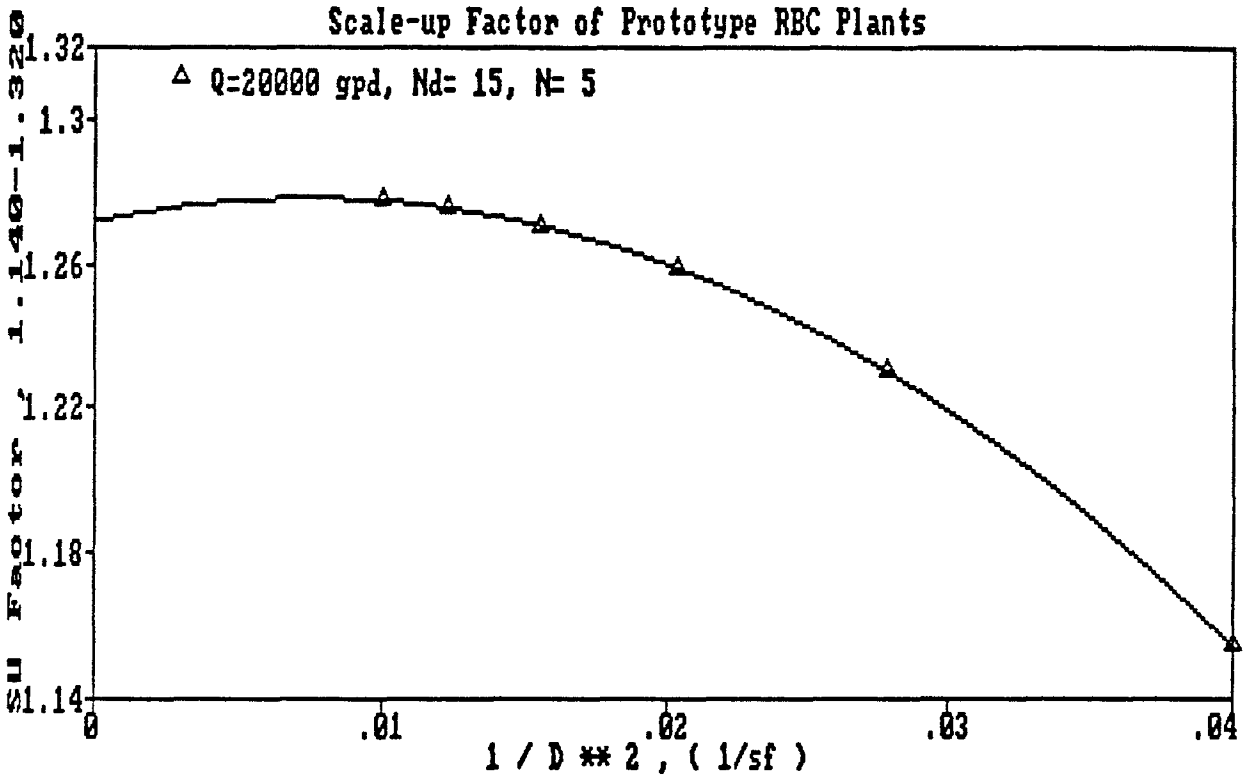
Scale-up Factor of Prototype RBC Plants
SU Factor , 1.180—1.300
1.3
1.28
1.26
1.24
1.22
1.2
1.18
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)
Q=16000 gpd, Nd= 35, N= 2
Q=16000 gpd, Nd= 35, N= 3
Q=16000 gpd, Nd= 35, N= 4
Q=16000 gpd, Nd= 35, N= 5

Figure V-50



Scale-up Factor of Prototype RBC Plants
Q=16000 gpd, Nd= 45, N= 2
Q=16000 gpd, Nd= 45, N= 3
Q=16000 gpd, Nd= 45, N= 4
Q=16000 gpd, Nd= 45, N= 5
SU Factor , 1.220-1.300
1.3
1.28
1.26
1.24
1.22
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-51



Scale-up Factor of Prototype RBC Plants
Q=20000 gpd, Nd= 15, N= 5
SU Factor, 1.140-1.320
1.32
1.3
1.26
1.22
1.18
1.14
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-52

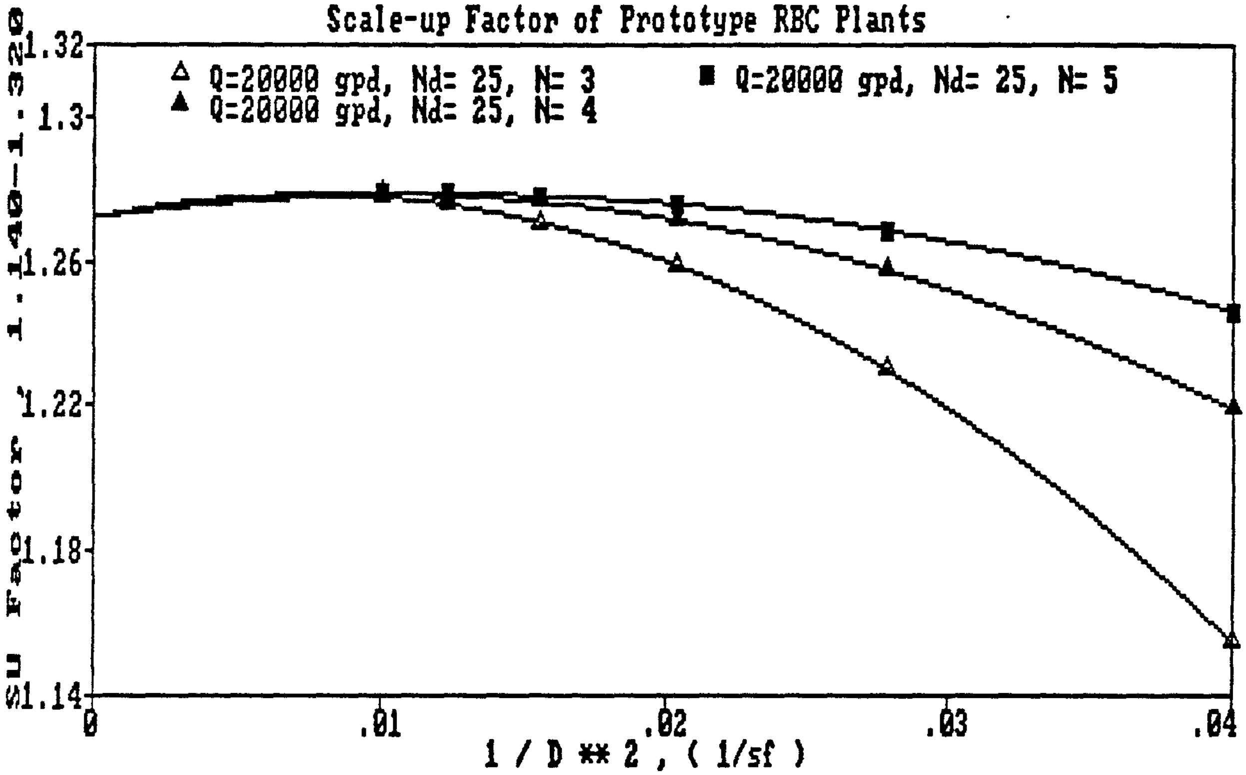
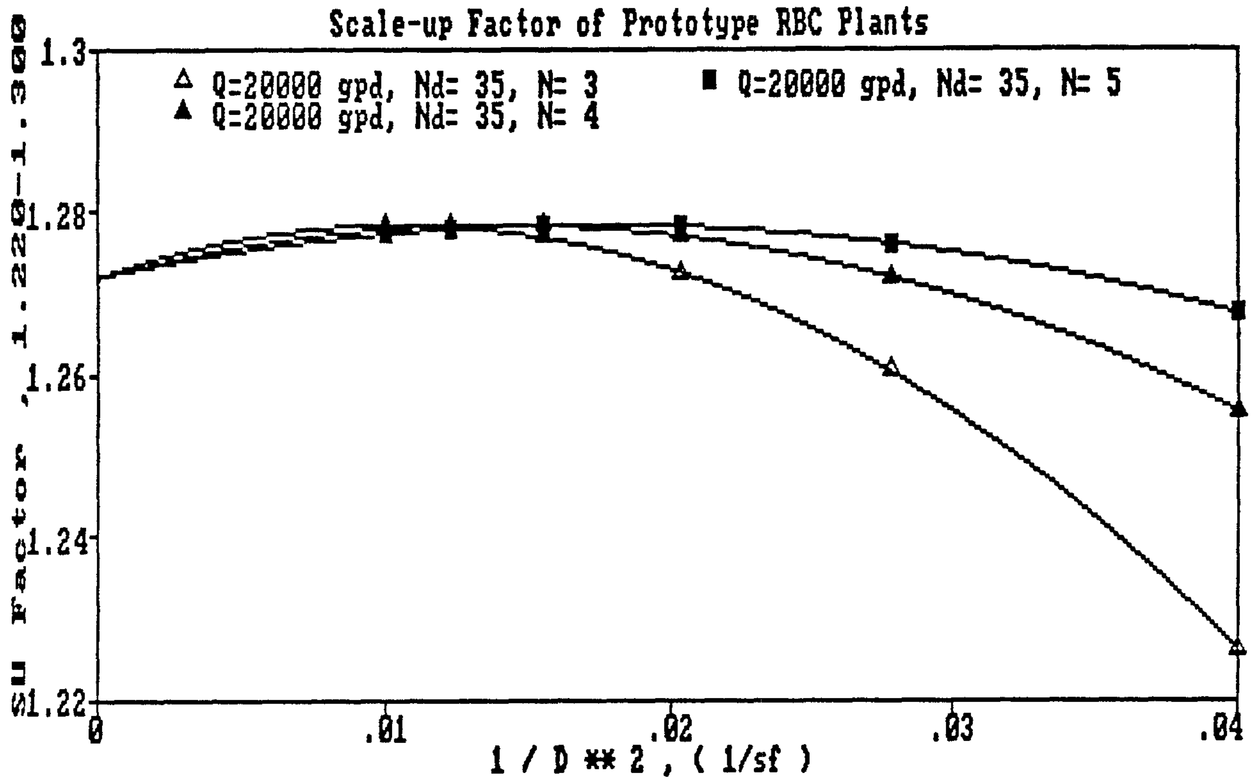

Scale-up Factor of Prototype RBC Plants
Q=20000 gpd, Nd= 25, N= 3
Q=20000 gpd, Nd= 25, N= 4
Q=20000 gpd, Nd= 25, N= 5
SU Factor, 1.140-1.320
1.32
1.3
1.26
1.22
1.18
1.14
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-53



Scale-up Factor of Prototype RBC Plants
Q=20000 gpd, Nd= 35, N= 3
Q=20000 gpd, Nd= 35, N= 4
Q=20000 gpd, Nd= 35, N= 5
SU Factor ,1.220-1.300
1.3
1.28
1.26
1.24
1.22
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-54

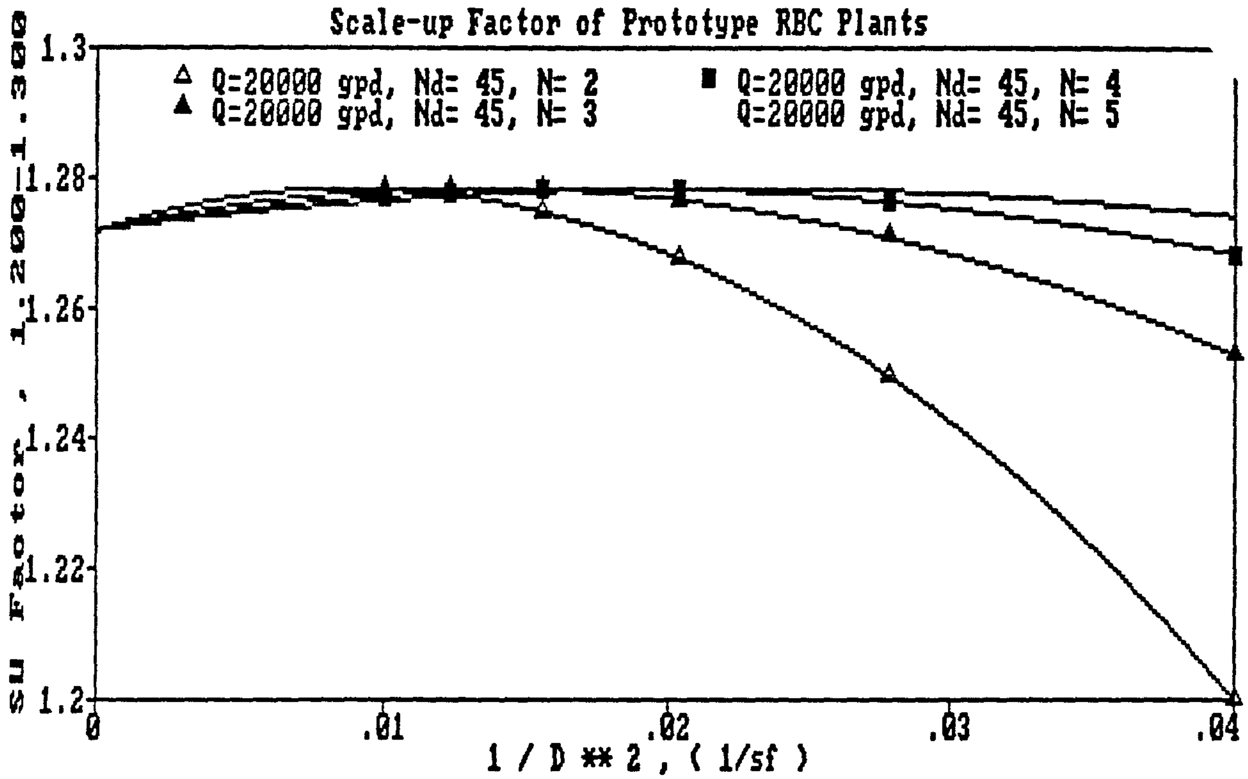

Scale-up Factor of Prototype RBC Plants
Q=20000 gpd, Nd= 45, N= 2
Q=20000 gpd, Nd= 45, N= 3
Q=20000 gpd, Nd= 45, N= 4
Q=20000 gpd, Nd= 45, N= 5
SU Factor , 1.200-1.300
1.3
1.28
1.26
1.24
1.22
1.2
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-55

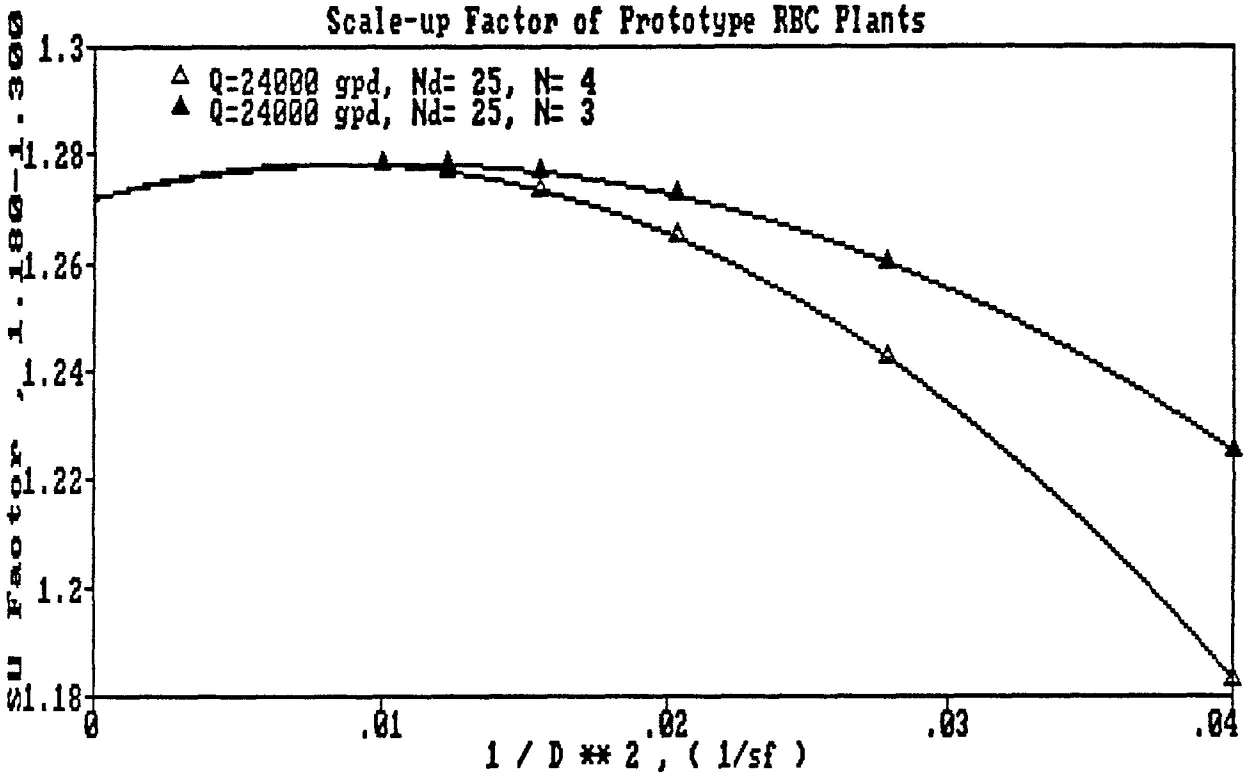
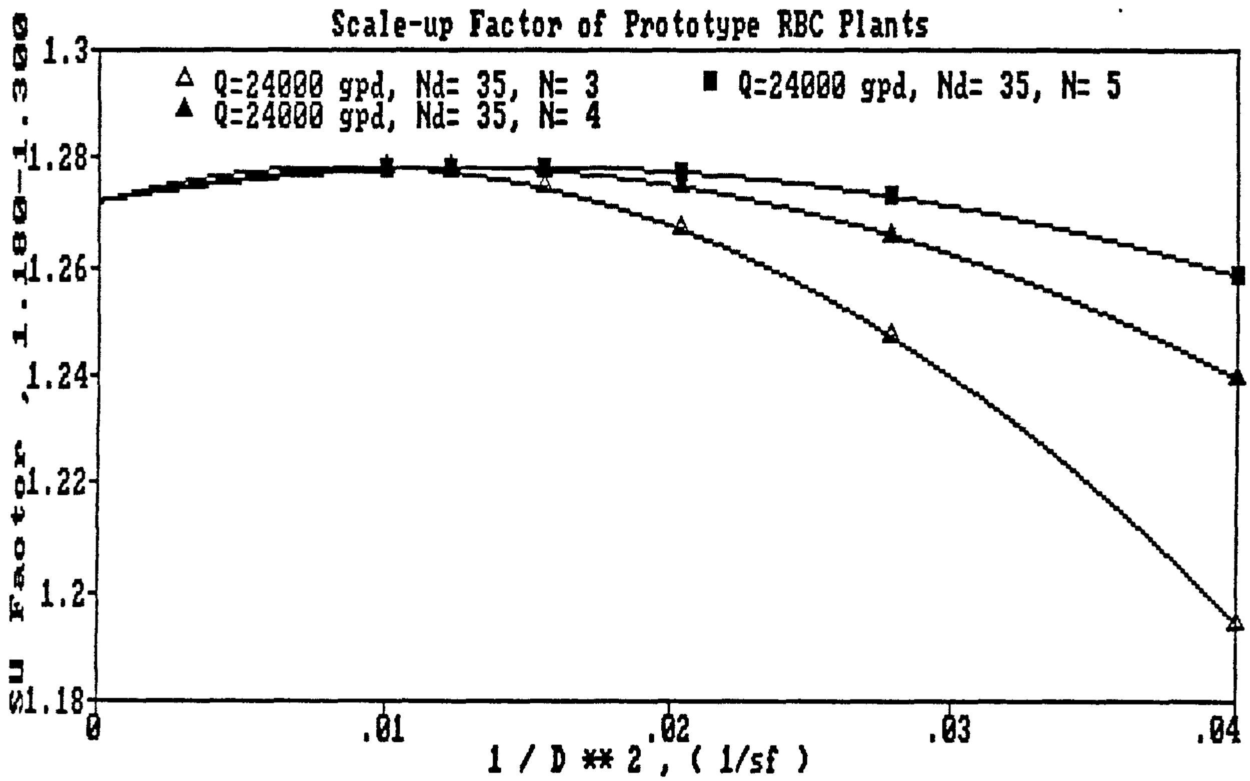
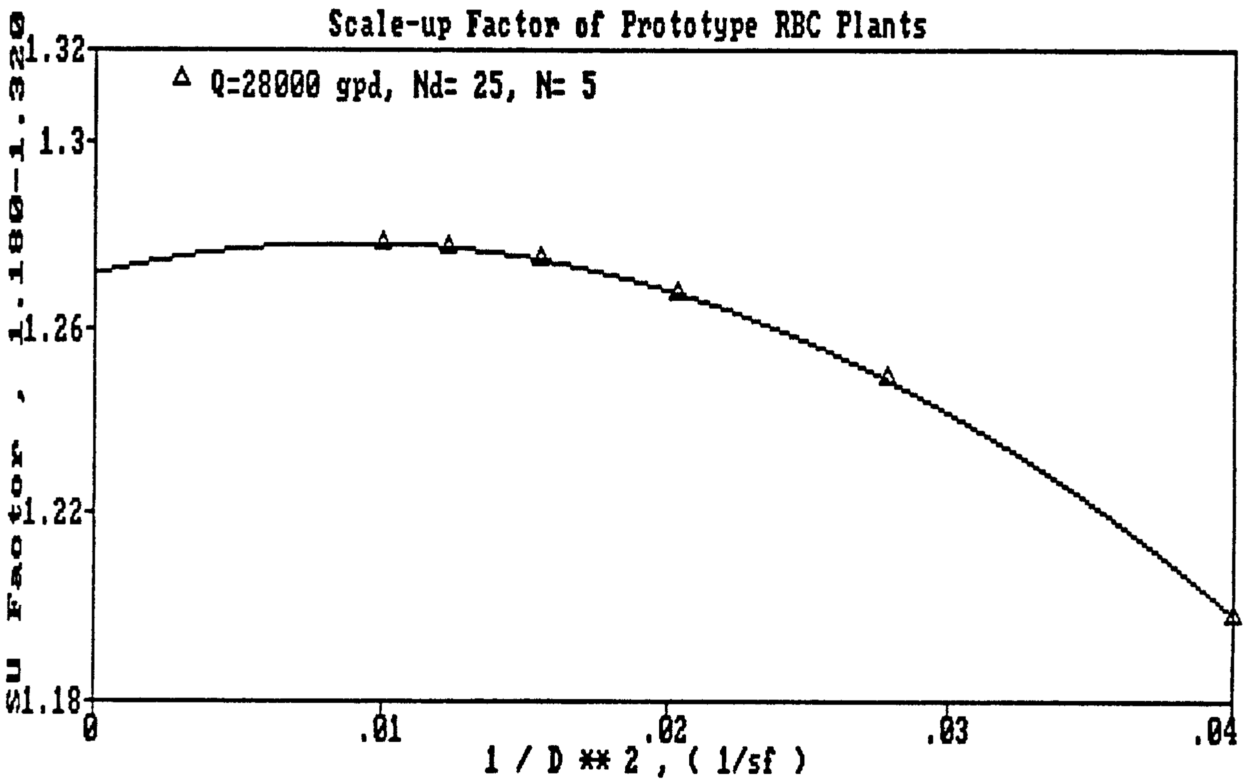

Scale-up Factor of Prototype RBC Plants
Q=24000 gpd, Nd= 25, N= 4
Q=24000 gpd, Nd= 25, N= 3
SU Factor ,1.180-1.300
1.3
1.28
1.26
1.24
1.22
1.2
1.18
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-56



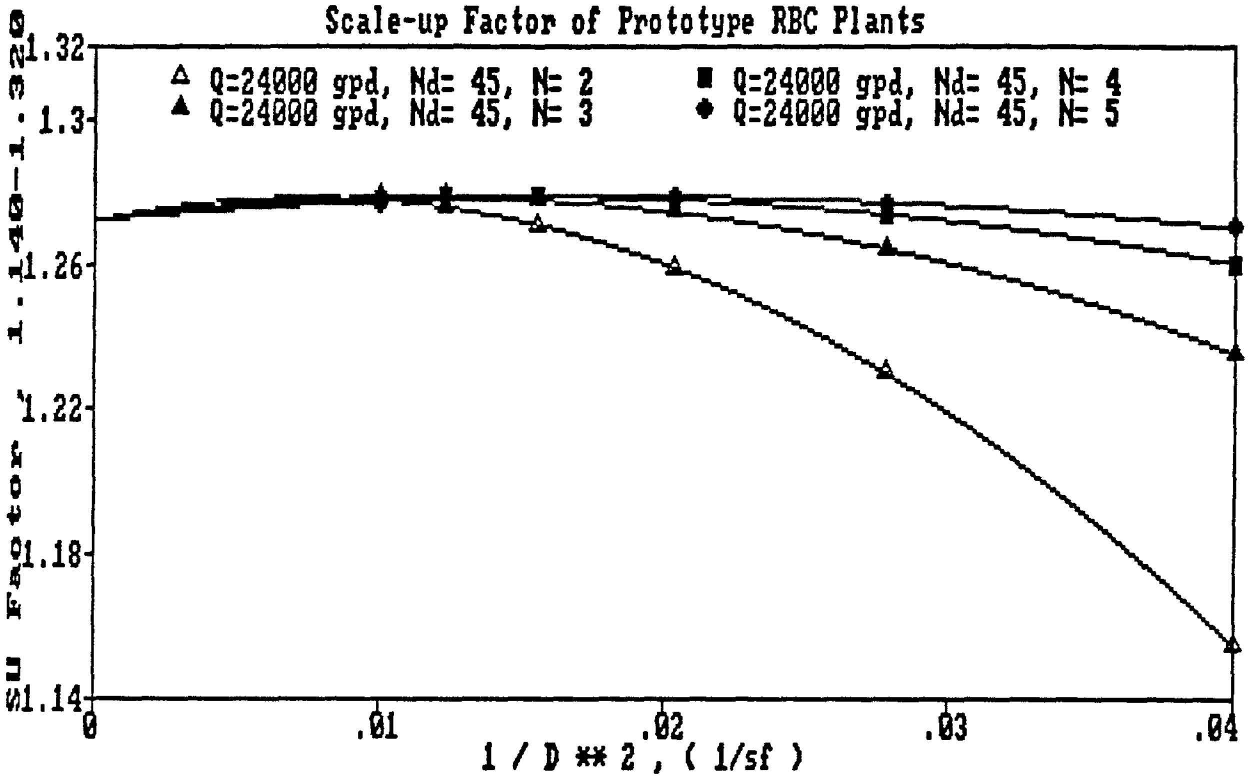
Scale-up Factor of Prototype RBC Plants
Q=24000 gpd, Nd= 35, N= 3
Q=24000 gpd, Nd= 35, N= 4
Q=24000 gpd, Nd= 35, N= 5
SU Factor , 1.180—1.300
1.3
1.28
1.26
1.24
1.22
1.2
1.18
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-57



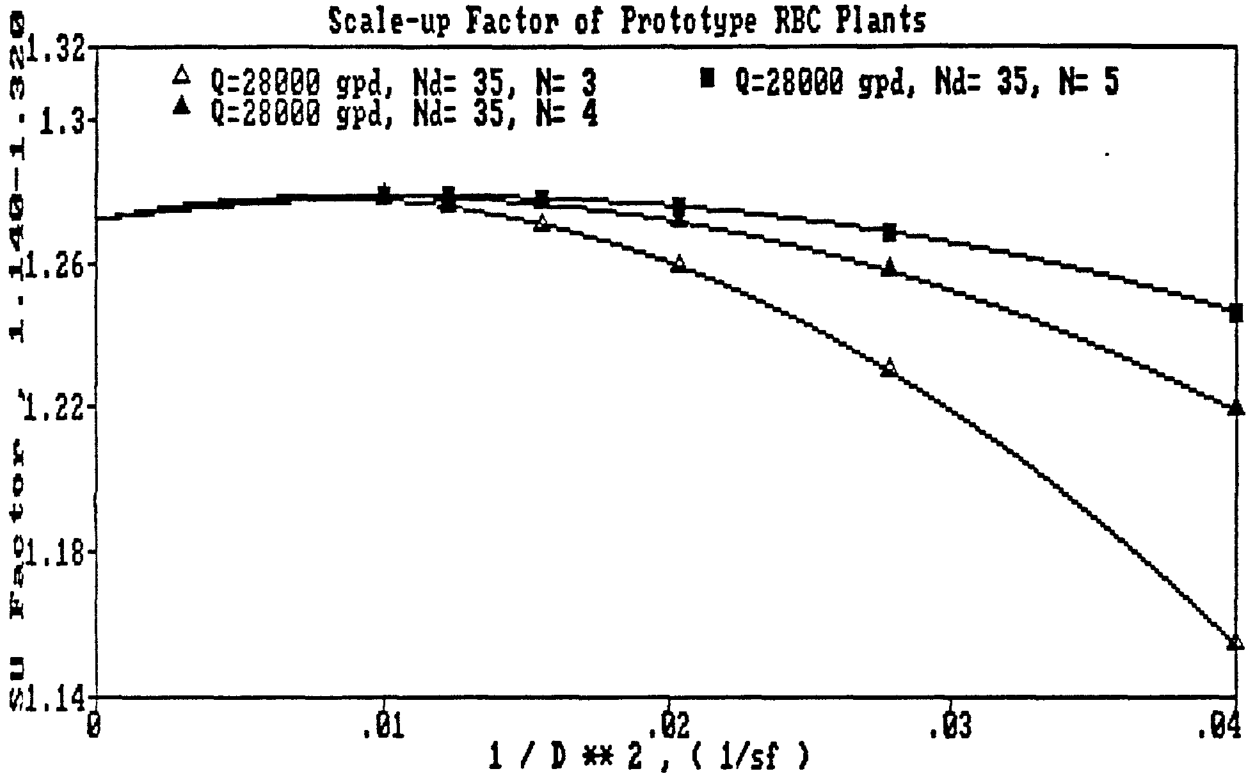
Scale-up Factor of Prototype RBC Plants
Q=28000 gpd, Nd= 25, N= 5
SU Factor , 1.180—1.320
1.32
1.3
1.26
1.22
1.18
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-59



Scale-up Factor of Prototype RBC Plants
Q=24000 gpd, Nd= 45, N= 2
Q=24000 gpd, Nd= 45, N= 3
Q=24000 gpd, Nd= 45, N= 4
Q=24000 gpd, Nd= 45, N= 5
SU Factor , 1.140-1.320
1.32
1.3
1.26
1.22
1.18
1.14
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-58



Scale-up Factor of Prototype RBC Plants
Q=28000 gpd, Nd= 35, N= 3
Q=28000 gpd, Nd= 35, N= 4
Q=28000 gpd, Nd= 35, N= 5
SU Factor, 1.140-1.320
1.32
1.3
1.26
1.22
1.18
1.14
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-60

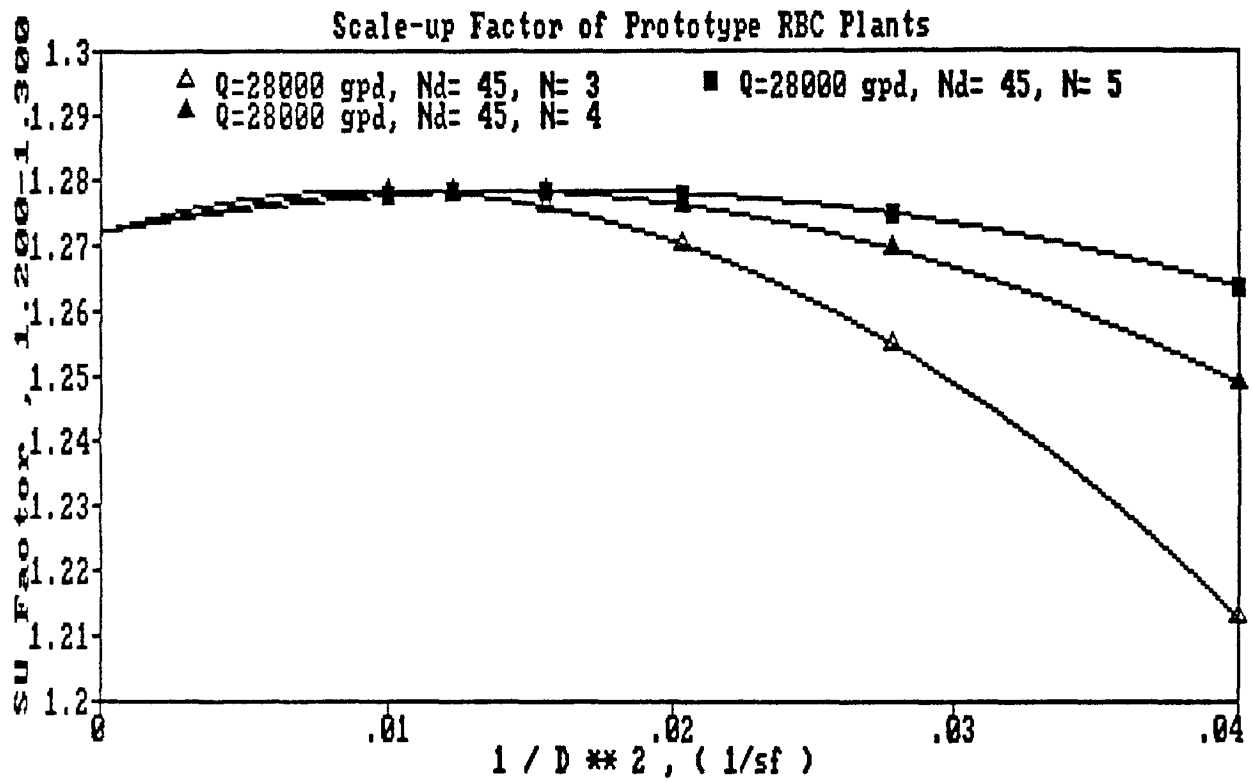
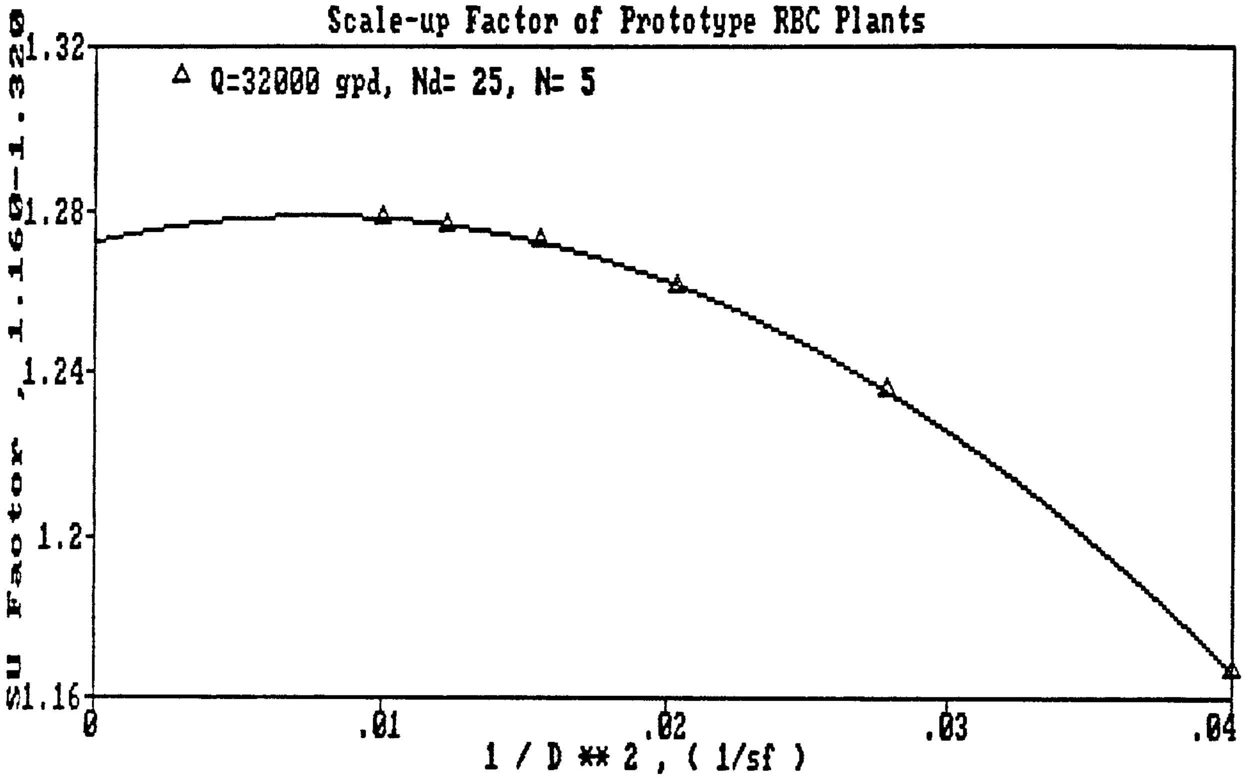
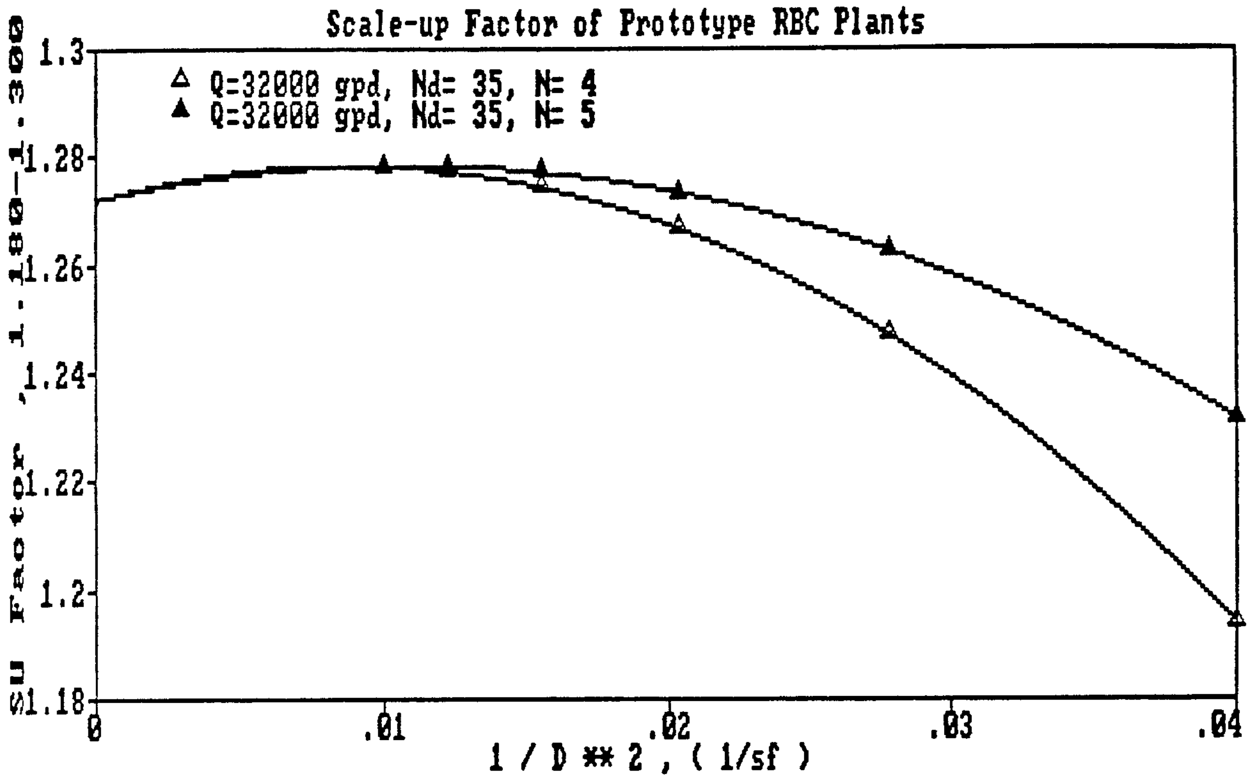

Scale-up Factor of Prototype RBC Plants
Q=28000 gpd, Nd= 45, N= 3
Q=28000 gpd, Nd= 45, N= 4
Q=28000 gpd, Nd= 45, N= 5
SU Factor, 1.200-1.300
1.3
1.29
1.28
1.27
1.26
1.25
1.24
1.23
1.22
1.21
1.2
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-61



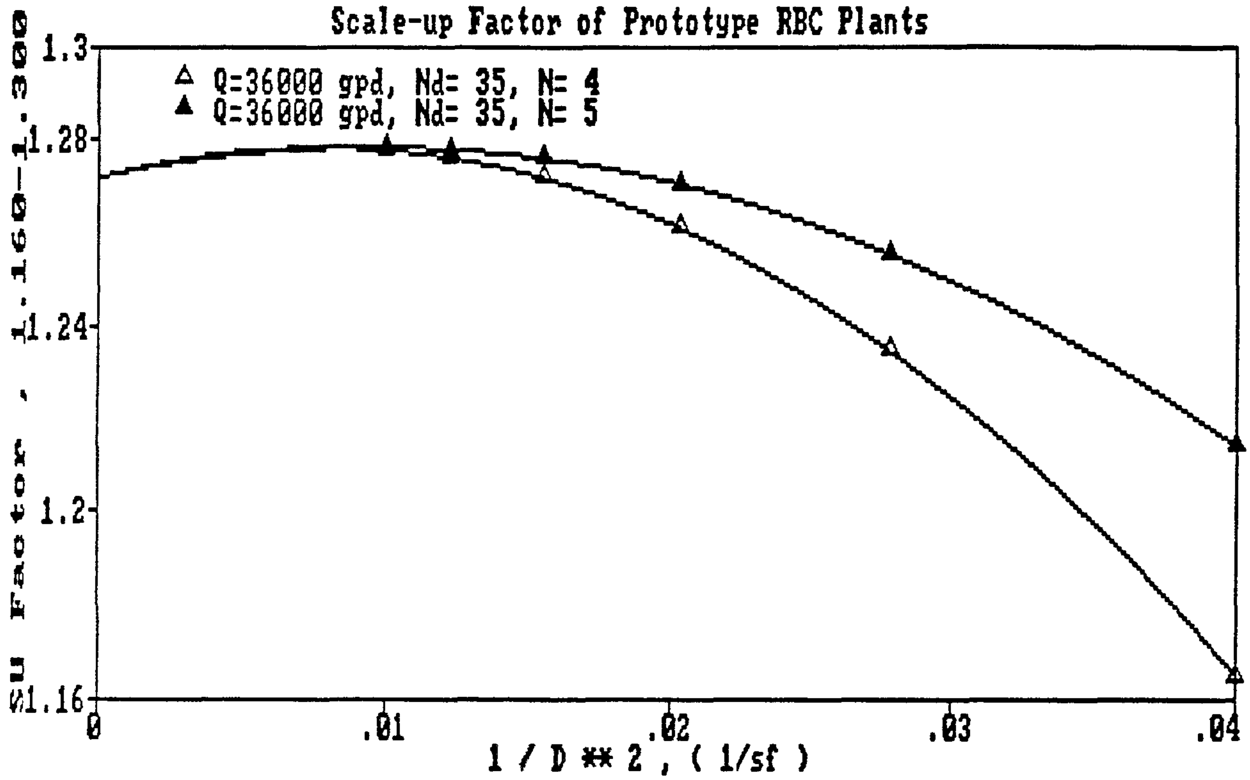
Scale-up Factor of Prototype RBC Plants
Q=32000 gpd, Nd= 25, N= 5
SU Factor , 1.160-1.320
1.32
1.28
1.24
1.2
1.16
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-62



Scale-up Factor of Prototype RBC Plants
Q=32000 gpd, Nd= 35, N= 4
Q=32000 gpd, Nd= 35, N= 5
SU Factor , 1.180—1.300
1.3
1.28
1.26
1.24
1.22
1.2
1.18
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-63



Scale-up Factor of Prototype RBC Plants
Q=36000 gpd, Nd= 35, N= 4
Q=36000 gpd, Nd= 35, N= 5
SU Factor , 1.160–1.300
1.3
1.28
1.24
1.2
1.16
0
.01
.02
.03
.04
1 / D ** 2 , (1/sf)

Figure V-64

VI. CONCLUSION

The developing of disc size scale-up for the different scale pilot plants is mainly according to Wu's predictive model which is available for the investigation and comparison with the operating data of RBC plants. A group of curves are created under different operating conditions and can be offered to the preparation of engineering preliminary design.

The results described above are summerized as below :

1. Under the same hydraulic loading, the sBOD remainings of different scale RBC plants are not the same. The larger the scale, the smaller the fraction of sBOD remaining is.

2. The value P of full-scale and prototype RBC plants can closely fit that of the predictive model, but the small scale has a larger deviation.

3. Basically, either the prototype or the small-scale RBC plants has smaller scale-up factors at higher hydraulic loadings.

4. For small-scale RBC plants under the given Q, N, and N_d , increasing of the disc diameter results in the decrease of hydraulic loading and the increase of scale-up factors, Therefore, enlarge the difference between P_f and P_s and increase the SBOD removal efficiency.

5. Under the given Q, N, N_d , the increase of disc size results in the decrease of hydraulic loading and the change of scale-up factors. The change is slightly as N is equal to 4 or 5. The scale-up factors decrease greatly as N is equal to 2.

VII. APPENDIX

Appendix contains one computer program and its input and output data. This program is used to do the calculations of sBOD remaining percentage and scale-up factors The former was performed by running data files which include total number of runs, number of stages (N), temperature (T), Hydraulic loading (q), influent concentration (L_0), and the effluent concentration of each stage. The latter was performed by interactive input which contain the referenced hydraulic loading q_c (=1.5), and the coefficient a,b, and c in each equation ,P_1(full)= f(q), P_1(prototype)= f(q), and P_1(small)= f(q).

The program was run on the VAX-11 system. The file name is 'rbc1.c'. The output file name are 'rbc1op.c', 'rbc2op.c' and 'rbc3op.c' respectively. Fig.V-1 to Fig. V-7 were completed by using the output data 'rbc1op.c'. Fig.V-10 to Fig.V-35 were obtained by using the output data 'rbc2op. Fig.V-36 to Fig.V-64 were plotted by using the output date 'rbc3op.c'.

APPENDIX A. COMPUTER PROGRAM AND INPUT DATA

```
C-----------------------------------------------------------------
C                                            ED. 2- DATA FILE
C
C                 RBC  WASTEWATER  TREAMENT  PROGRAM
C           BOD  REMOVAL PREDICTION & PILOT PLANT SCALE-UP
C                     USING  WU'S  MODEL
C
C                            BY
C                      CHANG CHI-SHENG
C                                            --FEB. 12, 1990
C
C                                            Mod. Apr. 18,1990
C-----------------------------------------------------------------
C
      program RBC1
      dimension S(10,10)
      OPEN(2,FILE='RBC1.DAT',STATUS='OLD')
      OPEN(3,FILE='RBC1OP.C',STATUS='NEW')
      open(4,file='rbc2op.c',status='new')
      open(5,file='rbc3op.c',status='new')
      REWIND 2
      REWIND 3
      rewind 4
      rewind 5
c
      write(6,10)
10    format(/2x,'1. For sBOD remaining, 2.For Scale-up factors',
     *        /2x'Please input the number of work'/)
        read(6,*) ns
      if(ns .eq.2) then
           call equat(a,b,c)
           go to 15
      else
        CALL INTRO(NTST)
        CALL READATA(I,NS,NEFF,NTST,DT1,DT2,DT3,S,RQ)
      endif
C
15     STOP
      END
C
C
C
      SUBROUTINE INTRO (NTST)
C
        WRITE(6,10)
 10     FORMAT(////10X,'THIS PROGRAM IS USED TO DO THE CALCULATION OF'
     *          /10X,'THE EQUATION  APPEARED  IN WUS MODEL THROUGH'
     *          /10X,'ENTERING THE REQUIRED  RBC EXPERIMENTAL DATA'
     *          /10X,'TO VERIFY  THE  PERFORMANCE OF WUS  MODEL   ')
C
        DO 30 I=1,3
          WRITE(6,20)
 20       FORMAT(/)
 30     CONTINUE
C
      NTST=0
      RETURN
```

```
      END
C
C
C
      SUBROUTINE READATA(I,NS,NEFF,NTST,DT1,DT2,DT3,S,RQ)
      DIMENSION  S(10,10)
      CHARACTER  A*75
C
      WRITE(6,2)
  2   FORMAT(/2X,'Please input the reference hydrolic loading, gpd/sf')
         READ(6,*) RQ
C
  5      READ(2,'(A)') A
          IF(A(1:30) .EQ.' ') GO TO 5
          IF(A(1:3) .EQ.'000') GO TO 220
          if(A(1:1) .eq.'*') go to 5
          IF(A(1:1) .EQ.'$') THEN
             READ(2,*) NR
             NTST=NTST+1
          ENDIF
        WRITE(3,30) NTST,A(4:74)
 30     FORMAT(//10X,'*EXP.',I2,'*',A72)
C
          DO 200 I=1,NR
               WRITE(3,35) I
 35            FORMAT(//12X,'RUN',I2,4X,'HL',3X,'TMP',2x,'INFL',3X,
     *                    'EFFL',2X,'RM1%',3X,'RM2%',2X,'REF%',4x,
     *                    'P1',3X,' P2 '/)
C
            READ(2,*)M,NS,NEFF,DT1,DT2,DT3
C          FORMAT(I3,I2,F5.0,F5.2,F5.1,A2)
                 READ(2,*) (S(I,J),J=1,NEFF)
            CALL CALPRT(I,NS,NEFF,DT1,DT2,DT3,S,RQ)
200         CONTINUE
              GO TO 5
C
220     RETURN
        END
C
C
C
      SUBROUTINE CALPRT(I,NS,NEFF,DT1,DT2,DT3,S,RQ)
      DIMENSION  S(10,10)
      CHARACTER  CHR1*7
C
        DO 50 K=1,NEFF
          IF(NS.GT.NEFF) THEN
            K1=NS
          ELSE
            K1=K
          ENDIF
C
           A1=14.2*DT2**0.5579
           A1A=14.2*RQ**0.5579
           A2=0.32*REAL(K1)
           A3=EXP(A2)
           A4=DT1**0.6837
```

```
         A5=DT3**0.2477
         A6=A3*A4*A5
        RMN1=(S(I,K)/DT1)*100.
        RMN2=(A1/A6)*100.
        RRMN=(A1A/A6)*100.
C
C Ratio of BOD remaining
C
        P1=RMN1/RRMN
        P2=RMN2/RRMN
        P3=P1/P2
C
          IF(NS.GT.NEFF) THEN
            CHR1=' Fnl'
          ELSE
            CHR1='Stg#'
          ENDIF
C
C
        WRITE(3,30) CHR1,K,DT2,DT3,DT1,S(I,K),RMN1,RMN2,RRMN,P1,P2
 30     FORMAT(13X,A4,I1,2X,F4.2,1X,F4.1,2X,F4.0,1X,F5.1,1X,
     *          3(F6.2,1x),2(f5.2,1X))
C
 50   CONTINUE
      RETURN
      END
c
c
      subroutine equat(a,b,c)
      write(6,10)
10    format(/2x,'Which scale your modeling plants would be ?',
     *        /2x,'1. small-scale or 2. prototype , Ansering 1 or 2'/)
        read(6,*) ncs
        write(6,20)
20      format(/2x,'Please input the coefficient a,b,and c of',
     *        /2x,'your equation:  ax**2+ b*x+ c'/)
          read(6,*)a,b,c
c
          if(ncs.eq.1) then
            call small(a,b,c)
          else
            call proto(a,b,c)
          endif
c
        return
        end
c
c
      subroutine proto(a,b,c)
      dimension pp6(7),pp7(7),suma(7)
c
       write(4,5)
5      format(//20x,'Scale-up factor of RBC PROTOTYPE plants')
c
       num=0
       Q=4000.
         do 100 k=1,9,1
```

```
          nd=15
           do 80 k1=1,4
             n=2
              do 60 k2=1,4
c  2nd term
        pp1=3.14159*real(n)*real(nd)
        pp2=(2*Q/pp1)
        pp3=b*pp2
c  1st term
        pp4=(pp2**2)*a
          d=5.0
          nj=6
c
         do 10 i=1,7,1
           pp5=d**2
           pp6(i)=1.0/pp5
           pp7(i)=pp2*(1.0/pp5)
c
            if(pp7(i).le. 7.0) then
              pp8=pp4*(1.0/pp5)**2
              pp9=pp3*(1.0/pp5)
              suma(i)=pp8+pp9+c
            else
              nj=nj-1
            endif
              d=d+1.0
10       continue
c
c
          if(nj.eq.6) then
            d=5.0
                 num=num+1
                 write(4,7) num, pp4, pp3, c
7                format(/11x,'curve #',i2,'    -->   ','a=',f10.5,2x,
     *                   'b=',f10.5,2x,'c=',f7.4)
              write(4,20)
20            format(/14x,'Dia.',7x,'Q',7x,'Nd',5x,'N',4x,
     *                '1/d**2',5x,'H.L.',6x,'SUF')
              do 40 i1=1,6,1
                 write(4,30) d,Q,nd,n,pp6(i1),pp7(i1),suma(i1)
30               format(14x,f3.0,6x,f6.0,4x,i2,5x,i1,4x,f6.4,4x,f5.3,
     *                       5x,f6.4)
            d=d+1.0
40            continue
          endif
c
            n=n+1
60        continue
            nd=nd+10
80       continue
           Q=Q+4000.
100     continue
c
       return
       end
c
c
```

```
      subroutine small(a,b,c)
      dimension pp6(5),pp7(6),suma(6)
c
       write(5,5)
5      format(//20x,'Scale-up Factor of SMALL scale RBC plants'/)
c
       num=0
          Q=200.
         do 100 j=1,11,1
           nd=15
            do 80 j1=1,4
               n=2
               do 60 j2=1,4
c  2nd term
         pp1=3.14159*real(n)*real(nd)
         pp2=(2*q/pp1)
         pp3=b*pp2
c  1st term
         pp4=(pp2**2)*a
           d=1.0
           nj=4
c
          do 10 i=1,4,1
            pp5=d**2
            pp6(i)=1.0/pp5
            pp7(i)=pp2*(1.0/pp5)
c
             if(pp7(i).le. 7.0) then
               pp8=pp4*(1.0/pp5)**2
               pp9=pp3*(1.0/pp5)
               suma(i)=pp8+pp9+c
             else
               nj=nj-1
             endif
               d=d+1.0
10        continue
c
c
           if(nj.eq.4) then
             d=1.0
                  num=num+1
                  write(5,7) num, pp4,pp3, c
7                 format(/11x,'curve #',i2,'   -->  ','a=',f8.5,2x,
     *                      'b=',f8.5,2x,'c=',f7.4)
                  write(5,20)
20                format(/17x,'Dia.',6x,'Q',7x,'Nd',5x,'N',4x,
     *                      '1/d**2',5x,'H.L.',6x,'SUF')
              do 40 i1=1,4,1
                  write(5,30) d,Q,nd,n,pp6(i1),pp7(i1),suma(i1)
30                format(17x,f3.1,6x,f5.0,4x,i2,5x,i1,4x,f6.4,4x,f5.3,
     *                      5x,f5.3)
                  d=d+1.0
40            continue
           endif
c
             n=n+1
60         continue
```

```
            nd=nd+10
80        continue
            Q=Q+200.
100     continue
c
        return
        end
```

```
****************** Format of Input Data ******************************
*
*   $ Title or Description
*     Total number of runs
*
*   Run#   Number of    Number of   Influent   Hydro. Loading   Temp.
*          stages, N    effluents     mg/L        q, gpd/sf       oC
*
*                                   Effluents N1, N2, N3 ...
**********************************************************************

*  $1-$5 are small-scale  ( D= 1.0 to 4.0 ft )

$1 RBC Unit in Saskatchewan, Canada (D=1.0 ft)
 10
 1 3 1 496 .75 10
       30
 2 3 1 480 .77  5
       50
 3 3 1 500 .37 10
       43
 4 4 1 398 .47 15
       15
 5 4 1 402 .46 10
       23
 6 4 1 389 .48  5
       33
 7 4 1 335 .28 15
       10
 8 4 1 375 .25 10
       13
 9 4 1 373 .26  5
       27
10 4 1 434 .21  1
       41

$2 Radford Army Ammunution Plant (D=1.5 ft)
 4
 1 4 1 212  1.6  10
      15
 2 4 1 250  1.6  8
      20
 3 4 1 235  1.6  10.5
      25
 4 4 1 155  1.6  12
      19

$3 Pilot Plant at Rhode Island. (D=1.64 ft)
 11
 1 4 1 141  .96  19
       13.5
 2 4 1 164  .92  19.2
       16.5
 3 4 1 211  1.97 18
       19
 4 4 1 242  .97  15
       21
```

```
 5 4 1 188  .92  14.5
       19.5
 6 4 1 163  .95  14
       14
 7 4 1 197  1.88 13.5
       26
 8 4 1 207  1.9  14.8
       24
 9 4 1 222  2.0  14.2
       24
10 4 1 192  1.98 13.5
       20
11 4 1 258  2.0  13
       32

$4  Autotrol Company Pilot Plant (D=2.0 ft)
 7
 1 4 1 145 1.50 17.2
       13
 2 4 1 115 1.5  13.9
       13
 3 4 1 149 1.5  15.0
       15.5
 4 4 1 228 1.23 9
       18
 5 4 1 330 1.23 9
       23
 6 4 1 355 1.23 9
       25
 7 4 1 392 1.23 9
       36

$5  Yankee Greyhound Inc. Dog Track-Piolt Plant (D=4 ft)
 10
 1 4 4 212 .45  12
       84   29  16  14
 2 4 4 275 .60  13
      133   50  43  13
 3 4 4 223 .90  11.5
      123   53  19  16
 4 4 4 265 .84  9.5
      118   62  27  22
 5 4 4 375 .72  12
      126   74  30  25
 6 4 4 250 .36  12.5
       68   42  11  19
 7 4 4 470 .23  18.8
       88   20  16   9
 8 4 4 400 .23  18
       89   39  21  18
 9 4 4 535 .36  20
      188   68  24  24
10 4 4 365 .14  19
       39   45  29   8
```

* $6 - $ 8 are Prototype (D= 5.0 to 10.5 ft)

```
$6 Pekaukee Treament Plant (D=5.74 ft)
 17
 1 2 1 172  .95  12.8
       15.5
 2 2 1 151  1.5  15
       21.2
 3 2 1 152  2.25 19
       27
 4 2 1 225  2.5  12
       37
 5 2 1 199  4.65 10
       53.8
 6 2 1 201  1.1  14.5
       15.5
 7 2 1  87  1.5  16
        18.2
 8 2 1 180  1.65 18
       22.5
 9 2 1 143  2.6  20
        30
10 2 1 139  4.78 17.5
       44.5
11 2 1 129  1.0  17.2
       18
12 2 1 156  1.6  19.4
       28
13 2 1 133  2.6  18
       33.8
14 2 1 123  .25  3.9
       12.3
15 2 1 131  .55  7.0
       19
16 2 1 183  1.1  8.5
       22.7
17 2 1 101  1.63 9.4
       34

$7 Pilot Plant at Pullman, Washington.(D=6.56 ft)
 4
 1 4 4  64  3.16  10
        40 23 21 27
 2 4 4  88  4.81  7.5
        45 32 21 22
 3 4 4  68  1.59  8.5
        23 13 16 14
 4 4 4  43  1.6  8.0
        18 17 12 10


$8 Piolt Plant at Madison Metropolitan Dist.,WC.(D=10.5 ft)
 5
 1 5 5  23   .78 10.3
        23    12  8.5   5   4
 2 5 5  20   .93 11.5
        18    12   7    5   3.5
 3 5 5  38   1.02 14.4
        20.5 10.5 7.0   4.5 3
```

```
 4 5 5  16.5 1.29 20
        10.2 9.7  5.5   3.5 2.5
 5 5 5  24   1.61 20.2
        19.7 15.5 13.0  7.5 6.5
```

```
*  $9- $12 are full-scale ( D >= 12 ft )

$9  RBC Plant of Enviroquip Inc., Austin, TX (D=11.7 ft)
 4
 1 4 4   54 .57  19
         15  13   4   3
 2 4 4   60 1.21 25
         29  11   6   5
 3 4 4   75 3.15 28
         55  34  15   9
 4 4 4   75 3.06 18
         35  28  13  10

$10  Grawfordsville Wastewater Treament Plant (D=12 ft)
 11
 1 1 1 102  4.4 13.5
        54
 2 1 1 119  6.3 12
        63
 3 1 1 109  5.9 13
        58
 4 1 1  82  6.4 16
        46
 5 1 1  85  5.5 20
        41
 6 1 1  69  5.2 22
        34
 7 1 1  59  5.2 22
        32
 8 1 1  59  4.8 21
        31
 9 1 1  61  4.5 19
        32
10 1 1  70  4.3 19
        40
11 1 1  69  4.7 17
        43

$11  Wastewater Treament Plant in Princeton, Illionis (D=12 ft)
 10
 1 5 5  22 1.17 15.1
        15.6 11.4  7.7  5.06  4.4
 2 5 5  23  .78  10.3
        23.0 13.6  8.74  5.30  4.1
 3 5 5  17  1.27  9.9
        17.0 10.7  6.8  4.76  3.06
 4 5 5  19  .93  11.5
        18.8 12.5  6.65 4.37  3.6
 5 5 5  8.2 2.02  13.9
        7.87 6.23  5.08  3.53 3.2
 6 5 5  11  1.28  17.6
```

```
         6.27 5.83  5.28  3.96 2.97
 7 5 5   16  1.28  20.1
         10.2  9.6  5.76  3.36  3.5
 8 5 5   30  1.16  20.0
         8.7   9    5.4   3.0   3.6
 9 5 5   28  1.04  17.7
         10.1  7.56  4.76  2.8  3.1
10 5 5   37  1.02  14.4
         21.1  11.5  7.0  4.07  3.7

$12  Autotrol Corporation in Milwaukee, Wis. (D=12.0 ft)
 8
 1 4 4   95  1.52  11.7
         44  23  14  9
 2 4 4   84  1.16  15.0
         34  17   8  6
 3 4 4   72  1.03  22.8
         24  12   6  5
 4 4 4   39  1.03  17.8
         12   8   6  6
 5 4 4   78  1.01  18.9
         36  16   8  6
 6 4 4   58  2.23  18.3
         43  24  15  10
 7 4 4   51  2.12  17.2
         35  24  16  11
 8 4 4   78  2.17  12.3
         56  34  25  13

000
```

APPENDIX B. OUTPUT DATA OF R_{m1}, R_{m2}, P_1 AND P_2 CALCULATION

EXP. 1 RBC Unit in Saskatchewan, Canada (D=1.0 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.75	10.0	496.	30.0	6.05	3.76	5.53	1.09	0.68

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.77	5.0	480.	50.0	10.42	4.63	6.72	1.55	0.69

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.37	10.0	500.	43.0	8.60	2.52	5.50	1.56	0.46

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.47	15.0	398.	15.0	3.77	2.21	4.22	0.89	0.52

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.46	10.0	402.	23.0	5.72	2.40	4.64	1.23	0.52

RUN 6	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.48	5.0	389.	33.0	8.48	2.98	5.63	1.51	0.53

RUN 7	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.28	15.0	335.	10.0	2.99	1.86	4.75	0.63	0.39

RUN 8	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.25	10.0	375.	13.0	3.47	1.79	4.86	0.71	0.37

RUN 9	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.26	5.0	373.	27.0	7.24	2.18	5.80	1.25	0.38

RUN10	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.21	1.0	434.	41.0	9.45	2.60	7.79	1.21	0.33

EXP. 2 Radford Army Ammunution Plant (D=1.5 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.60	10.0	212.	15.0	7.08	7.45	7.18	0.98	1.04

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.60	8.0	250.	20.0	8.00	7.03	6.78	1.18	1.04

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.60	10.5	235.	25.0	10.64	6.86	6.62	1.61	1.04

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.60	12.0	155.	19.0	12.26	8.82	8.51	1.44	1.04

EXP. 3 Pilot Plant at Rhode Island. (D=1.64 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.96	19.0	141.	13.5	9.57	6.31	8.10	1.18	0.78

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.92	19.2	164.	16.5	10.06	5.55	7.29	1.38	0.76

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.97	18.0	211.	19.0	9.00	7.25	6.23	1.45	1.16

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.97	15.0	242.	21.0	8.68	4.65	5.94	1.46	0.78

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.92	14.5	188.	19.5	10.37	5.42	7.11	1.46	0.76

RUN 6	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.95	14.0	163.	14.0	8.59	6.13	7.91	1.09	0.78

RUN 7	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2

Fnl1	1.88	13.5	197.	26.0	13.20	7.95	7.01	1.88	1.13

RUN 8	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.90	14.8	207.	24.0	11.59	7.56	6.63	1.75	1.14

RUN 9	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	2.00	14.2	222.	24.0	10.81	7.49	6.38	1.69	1.17

RUN10	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.98	13.5	192.	20.0	10.42	8.33	7.14	1.46	1.17

RUN11	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	2.00	13.0	258.	32.0	12.40	6.91	5.89	2.11	1.17

EXP. 4 Autotrol Company Pilot Plant (D=2.0 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.50	17.2	145.	13.0	8.97	8.14	8.14	1.10	1.00

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.50	13.9	115.	13.0	11.30	10.06	10.06	1.12	1.00

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.50	15.0	149.	15.5	10.40	8.27	8.27	1.26	1.00

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.23	9.0	228.	18.0	7.89	6.28	7.02	1.13	0.90

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.23	9.0	330.	23.0	6.97	4.88	5.45	1.28	0.90

RUN 6	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.23	9.0	355.	25.0	7.04	4.64	5.18	1.36	0.90

RUN 7	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2

Fnl1	1.23	9.0	392.	36.0	9.18	4.34	4.84	1.90	0.90

EXP. 5 Yankee Greyhound Inc. Dog Track-Piolt Plant (D=4 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.45	12.0	212.	84.0	39.62	9.16	17.94	2.21	0.51
Stg#2	0.45	12.0	212.	29.0	13.68	6.65	13.02	1.05	0.51
Stg#3	0.45	12.0	212.	16.0	7.55	4.83	9.46	0.80	0.51
Stg#4	0.45	12.0	212.	14.0	6.60	3.51	6.87	0.96	0.51

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.60	13.0	275.	133.0	48.36	8.83	14.72	3.29	0.60
Stg#2	0.60	13.0	275.	50.0	18.18	6.41	10.69	1.70	0.60
Stg#3	0.60	13.0	275.	43.0	15.64	4.65	7.76	2.01	0.60
Stg#4	0.60	13.0	275.	13.0	4.73	3.38	5.64	0.84	0.60

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.90	11.5	223.	123.0	55.16	13.17	17.51	3.15	0.75
Stg#2	0.90	11.5	223.	53.0	23.77	9.56	12.71	1.87	0.75
Stg#3	0.90	11.5	223.	19.0	8.52	6.94	9.23	0.92	0.75
Stg#4	0.90	11.5	223.	16.0	7.17	5.04	6.70	1.07	0.75

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.84	9.5	265.	118.0	44.53	11.81	16.32	2.73	0.72
Stg#2	0.84	9.5	265.	62.0	23.40	8.57	11.85	1.97	0.72
Stg#3	0.84	9.5	265.	27.0	10.19	6.23	8.60	1.18	0.72
Stg#4	0.84	9.5	265.	22.0	8.30	4.52	6.25	1.33	0.72

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.72	12.0	375.	126.0	33.60	8.06	12.14	2.77	0.66
Stg#2	0.72	12.0	375.	74.0	19.73	5.86	8.82	2.24	0.66
Stg#3	0.72	12.0	375.	30.0	8.00	4.25	6.40	1.25	0.66
Stg#4	0.72	12.0	375.	25.0	6.67	3.09	4.65	1.43	0.66

RUN 6	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.36	12.5	250.	68.0	27.20	7.15	15.86	1.71	0.45
Stg#2	0.36	12.5	250.	42.0	16.80	5.20	11.52	1.46	0.45
Stg#3	0.36	12.5	250.	11.0	4.40	3.77	8.36	0.53	0.45
Stg#4	0.36	12.5	250.	19.0	7.60	2.74	6.07	1.25	0.45

RUN 7	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2

	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.23	18.8	470.	88.0	18.72	3.27	9.31	2.01	0.35
Stg#2	0.23	18.8	470.	20.0	4.26	2.38	6.76	0.63	0.35
Stg#3	0.23	18.8	470.	16.0	3.40	1.72	4.91	0.69	0.35
Stg#4	0.23	18.8	470.	9.0	1.91	1.25	3.57	0.54	0.35

RUN 8	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.23	18.0	400.	89.0	22.25	3.69	10.51	2.12	0.35
Stg#2	0.23	18.0	400.	39.0	9.75	2.68	7.63	1.28	0.35
Stg#3	0.23	18.0	400.	21.0	5.25	1.95	5.54	0.95	0.35
Stg#4	0.23	18.0	400.	18.0	4.50	1.41	4.02	1.12	0.35

RUN 9	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.36	20.0	535.	188.0	35.14	3.79	8.39	4.19	0.45
Stg#2	0.36	20.0	535.	68.0	12.71	2.75	6.09	2.09	0.45
Stg#3	0.36	20.0	535.	24.0	4.49	2.00	4.43	1.01	0.45
Stg#4	0.36	20.0	535.	24.0	4.49	1.45	3.21	1.40	0.45

RUN10	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.14	19.0	365.	39.0	10.68	2.94	11.04	0.97	0.27
Stg#2	0.14	19.0	365.	45.0	12.33	2.13	8.02	1.54	0.27
Stg#3	0.14	19.0	365.	29.0	7.95	1.55	5.82	1.36	0.27
Stg#4	0.14	19.0	365.	8.0	2.19	1.13	4.23	0.52	0.27

EXP. 6 Pekaukee Treament Plant (D=5.74 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	0.95	12.8	172.	15.5	9.01	11.46	14.79	0.61	0.78

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	1.50	15.0	151.	21.2	14.04	15.54	15.54	0.90	1.00

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	2.25	19.0	152.	27.0	17.76	18.30	14.59	1.22	1.25

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	2.50	12.0	225.	37.0	16.44	16.63	12.50	1.32	1.33

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fnl1	4.65	10.0	199.	53.8	27.04	26.75	14.23	1.90	1.88

RUN 6	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	1.10	14.5	201.	15.5	7.71	10.84	12.89	0.60	0.84

RUN 7	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	1.50	16.0	87.	18.2	20.92	22.30	22.30	0.94	1.00

RUN 8	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	1.65	18.0	180.	22.5	12.50	13.89	13.17	0.95	1.05

RUN 9	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	2.60	20.0	143.	30.0	20.98	20.42	15.02	1.40	1.36

RUN10	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	4.78	17.5	139.	44.5	32.01	30.22	15.83	2.02	1.91

RUN11	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	1.00	17.2	129.	18.0	13.95	13.34	16.73	0.83	0.80

RUN12	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	1.60	19.4	156.	28.0	17.95	14.78	14.26	1.26	1.04

RUN13	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	2.60	18.0	133.	33.8	25.41	22.02	16.20	1.57	1.36

RUN14	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	0.25	3.9	123.	12.3	10.00	9.19	24.96	0.40	0.37

RUN15	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	0.55	7.0	131.	19.0	14.50	11.82	20.69	0.70	0.57

RUN16	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Fn11	1.10	8.5	183.	22.7	12.40	13.19	15.69	0.79	0.84

RUN17	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2

Fnl1	1.63	9.4	101.	34.0	33.66	24.06	22.97	1.47	1.05

EXP. 7 Pilot Plant at Pullman, Washington.(D=6.56 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	3.16	10.0	64.	40.0	62.50	64.49	42.56	1.47	1.52
Stg#2	3.16	10.0	64.	23.0	35.94	46.83	30.90	1.16	1.52
Stg#3	3.16	10.0	64.	21.0	32.81	34.01	22.44	1.46	1.52
Stg#4	3.16	10.0	64.	27.0	42.19	24.69	16.29	2.59	1.52

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	4.81	7.5	88.	45.0	51.14	70.42	36.76	1.39	1.92
Stg#2	4.81	7.5	88.	32.0	36.36	51.13	26.69	1.36	1.92
Stg#3	4.81	7.5	88.	21.0	23.86	37.13	19.38	1.23	1.92
Stg#4	4.81	7.5	88.	22.0	25.00	26.96	14.07	1.78	1.92

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.59	8.5	68.	23.0	33.82	43.91	42.51	0.80	1.03
Stg#2	1.59	8.5	68.	13.0	19.12	31.89	30.87	0.62	1.03
Stg#3	1.59	8.5	68.	16.0	23.53	23.15	22.41	1.05	1.03
Stg#4	1.59	8.5	68.	14.0	20.59	16.81	16.28	1.26	1.03

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.60	8.0	43.	18.0	41.86	61.19	59.03	0.71	1.04
Stg#2	1.60	8.0	43.	17.0	39.53	44.43	42.86	0.92	1.04
Stg#3	1.60	8.0	43.	12.0	27.91	32.27	31.12	0.90	1.04
Stg#4	1.60	8.0	43.	10.0	23.26	23.43	22.60	1.03	1.04

EXP. 8 Piolt Plant at Madison Metropolitan Dist.,WC.(D=10.5 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.78	10.3	23.	23.0	100.00	59.05	85.05	1.18	0.69
Stg#2	0.78	10.3	23.	12.0	52.17	42.88	61.76	0.84	0.69
Stg#3	0.78	10.3	23.	8.5	36.96	31.14	44.84	0.82	0.69
Stg#4	0.78	10.3	23.	5.0	21.74	22.61	32.56	0.67	0.69
Stg#5	0.78	10.3	23.	4.0	17.39	16.42	23.65	0.74	0.69

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.93	11.5	20.	18.0	90.00	69.74	91.06	0.99	0.77
Stg#2	0.93	11.5	20.	12.0	60.00	50.64	66.12	0.91	0.77
Stg#3	0.93	11.5	20.	7.0	35.00	36.77	48.01	0.73	0.77
Stg#4	0.93	11.5	20.	5.0	25.00	26.70	34.86	0.72	0.77

Stg#5	0.93	11.5	20.	3.5	17.50	19.39	25.32	0.69	0.77

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.02	14.4	38.	20.5	53.95	44.78	55.53	0.97	0.81
Stg#2	1.02	14.4	38.	10.5	27.63	32.52	40.32	0.69	0.81
Stg#3	1.02	14.4	38.	7.0	18.42	23.61	29.28	0.63	0.81
Stg#4	1.02	14.4	38.	4.5	11.84	17.15	21.26	0.56	0.81
Stg#5	1.02	14.4	38.	3.0	7.89	12.45	15.44	0.51	0.81

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.29	20.0	17.	10.2	61.82	83.24	90.55	0.68	0.92
Stg#2	1.29	20.0	17.	9.7	58.79	60.45	65.75	0.89	0.92
Stg#3	1.29	20.0	17.	5.5	33.33	43.89	47.75	0.70	0.92
Stg#4	1.29	20.0	17.	3.5	21.21	31.87	34.67	0.61	0.92
Stg#5	1.29	20.0	17.	2.5	15.15	23.14	25.18	0.60	0.92

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.61	20.2	24.	19.7	82.08	72.73	69.91	1.17	1.04
Stg#2	1.61	20.2	24.	15.5	64.58	52.81	50.77	1.27	1.04
Stg#3	1.61	20.2	24.	13.0	54.17	38.35	36.87	1.47	1.04
Stg#4	1.61	20.2	24.	7.5	31.25	27.85	26.77	1.17	1.04
Stg#5	1.61	20.2	24.	6.5	27.08	20.22	19.44	1.39	1.04

EXP. 9 RBC Plant of Enviroquip Inc., Austin, TX (D=11.7 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.57	19.0	54.	15.0	27.78	23.76	40.77	0.68	0.58
Stg#2	0.57	19.0	54.	13.0	24.07	17.26	29.61	0.81	0.58
Stg#3	0.57	19.0	54.	4.0	7.41	12.53	21.50	0.34	0.58
Stg#4	0.57	19.0	54.	3.0	5.56	9.10	15.61	0.36	0.58

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.21	25.0	60.	29.0	48.33	31.44	35.45	1.36	0.89
Stg#2	1.21	25.0	60.	11.0	18.33	22.83	25.74	0.71	0.89
Stg#3	1.21	25.0	60.	6.0	10.00	16.58	18.69	0.54	0.89
Stg#4	1.21	25.0	60.	5.0	8.33	12.04	13.57	0.61	0.89

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	3.15	28.0	75.	55.0	73.33	44.76	29.59	2.48	1.51
Stg#2	3.15	28.0	75.	34.0	45.33	32.50	21.49	2.11	1.51
Stg#3	3.15	28.0	75.	15.0	20.00	23.60	15.60	1.28	1.51
Stg#4	3.15	28.0	75.	9.0	12.00	17.14	11.33	1.06	1.51

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	3.06	18.0	75.	35.0	46.67	49.13	33.01	1.41	1.49
Stg#2	3.06	18.0	75.	28.0	37.33	35.68	23.97	1.56	1.49
Stg#3	3.06	18.0	75.	13.0	17.33	25.91	17.41	1.00	1.49
Stg#4	3.06	18.0	75.	10.0	13.33	18.81	12.64	1.05	1.49

EXP.10   Grawfordsville Wastewater Treament Plant (D=12 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	4.40	13.5	102.	54.0	52.94	52.36	28.73	1.84	1.82

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	6.30	12.0	119.	63.0	52.94	59.28	26.62	1.99	2.23

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	5.90	13.0	109.	58.0	53.21	59.49	27.71	1.92	2.15

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	6.40	16.0	82.	46.0	56.10	71.84	31.98	1.75	2.25

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	5.50	20.0	85.	41.0	48.24	60.95	29.52	1.63	2.06

RUN 6	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	5.20	22.0	69.	34.0	49.28	66.53	33.25	1.48	2.00

RUN 7	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	5.20	22.0	59.	32.0	54.24	74.05	37.01	1.47	2.00

RUN 8	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	4.80	21.0	59.	31.0	52.54	71.64	37.44	1.40	1.91

RUN 9	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	4.50	19.0	61.	32.0	52.46	69.24	37.51	1.40	1.85

RUN10	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2

Stg#1	4.30	19.0	70.	40.0	57.14	61.44	34.14	1.67	1.80

RUN11	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	4.70	17.0	69.	43.0	62.32	67.03	35.44	1.76	1.89

EXP.11 Wastewater Treament Plant in Princeton, Illionis (D=12 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.17	15.1	22.	15.6	70.91	69.42	79.75	0.89	0.87
Stg#2	1.17	15.1	22.	11.4	51.82	50.41	57.91	0.89	0.87
Stg#3	1.17	15.1	22.	7.7	35.00	36.61	42.05	0.83	0.87
Stg#4	1.17	15.1	22.	5.1	23.00	26.58	30.53	0.75	0.87
Stg#5	1.17	15.1	22.	4.4	20.00	19.30	22.17	0.90	0.87

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.78	10.3	23.	23.0	100.00	59.05	85.05	1.18	0.69
Stg#2	0.78	10.3	23.	13.6	59.13	42.88	61.76	0.96	0.69
Stg#3	0.78	10.3	23.	8.7	38.00	31.14	44.84	0.85	0.69
Stg#4	0.78	10.3	23.	5.3	23.04	22.61	32.56	0.71	0.69
Stg#5	0.78	10.3	23.	4.1	17.83	16.42	23.65	0.75	0.69

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.27	9.9	17.	17.0	100.00	96.24	105.60	0.95	0.91
Stg#2	1.27	9.9	17.	10.7	62.94	69.88	76.68	0.82	0.91
Stg#3	1.27	9.9	17.	6.8	40.00	50.75	55.68	0.72	0.91
Stg#4	1.27	9.9	17.	4.8	28.00	36.85	40.43	0.69	0.91
Stg#5	1.27	9.9	17.	3.1	18.00	26.76	29.36	0.61	0.91

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	0.93	11.5	19.	18.8	98.95	72.23	94.31	1.05	0.77
Stg#2	0.93	11.5	19.	12.5	65.79	52.45	68.48	0.96	0.77
Stg#3	0.93	11.5	19.	6.7	35.00	38.09	49.73	0.70	0.77
Stg#4	0.93	11.5	19.	4.4	23.00	27.66	36.11	0.64	0.77
Stg#5	0.93	11.5	19.	3.6	18.95	20.08	26.22	0.72	0.77

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	2.02	13.9	8.	7.9	95.98	188.70	159.83	0.60	1.18
Stg#2	2.02	13.9	8.	6.2	75.98	137.02	116.06	0.65	1.18
Stg#3	2.02	13.9	8.	5.1	61.95	99.50	84.28	0.74	1.18
Stg#4	2.02	13.9	8.	3.5	43.05	72.25	61.20	0.70	1.18
Stg#5	2.02	13.9	8.	3.2	39.02	52.47	44.44	0.88	1.18

RUN 6	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.28	17.6	11.	6.3	57.00	112.88	123.32	0.46	0.92
Stg#2	1.28	17.6	11.	5.8	53.00	81.97	89.55	0.59	0.92
Stg#3	1.28	17.6	11.	5.3	48.00	59.52	65.03	0.74	0.92
Stg#4	1.28	17.6	11.	4.0	36.00	43.22	47.22	0.76	0.92
Stg#5	1.28	17.6	11.	3.0	27.00	31.38	34.29	0.79	0.92

RUN 7	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.28	20.1	16.	10.2	63.75	84.54	92.36	0.69	0.92
Stg#2	1.28	20.1	16.	9.6	60.00	61.39	67.07	0.89	0.92
Stg#3	1.28	20.1	16.	5.8	36.00	44.58	48.70	0.74	0.92
Stg#4	1.28	20.1	16.	3.4	21.00	32.37	35.37	0.59	0.92
Stg#5	1.28	20.1	16.	3.5	21.88	23.51	25.68	0.85	0.92

RUN 8	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.16	20.0	30.	8.7	29.00	52.13	60.17	0.48	0.87
Stg#2	1.16	20.0	30.	9.0	30.00	37.86	43.69	0.69	0.87
Stg#3	1.16	20.0	30.	5.4	18.00	27.49	31.73	0.57	0.87
Stg#4	1.16	20.0	30.	3.0	10.00	19.96	23.04	0.43	0.87
Stg#5	1.16	20.0	30.	3.6	12.00	14.49	16.73	0.72	0.87

RUN 9	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.04	17.7	28.	10.1	36.07	53.00	65.01	0.55	0.82
Stg#2	1.04	17.7	28.	7.6	27.00	38.49	47.21	0.57	0.82
Stg#3	1.04	17.7	28.	4.8	17.00	27.95	34.28	0.50	0.82
Stg#4	1.04	17.7	28.	2.8	10.00	20.29	24.89	0.40	0.82
Stg#5	1.04	17.7	28.	3.1	11.07	14.74	18.08	0.61	0.82

RUN10	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.02	14.4	37.	21.1	57.03	45.60	56.55	1.01	0.81
Stg#2	1.02	14.4	37.	11.5	31.08	33.12	41.07	0.76	0.81
Stg#3	1.02	14.4	37.	7.0	18.92	24.05	29.82	0.63	0.81
Stg#4	1.02	14.4	37.	4.1	11.00	17.46	21.65	0.51	0.81
Stg#5	1.02	14.4	37.	3.7	10.00	12.68	15.72	0.64	0.81

EXP.12   Autotrol Corporation in Milwaukee, Wis. (D=12.0 ft)

RUN 1	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.52	11.7	95.	44.0	46.32	31.48	31.25	1.48	1.01
Stg#2	1.52	11.7	95.	23.0	24.21	22.86	22.69	1.07	1.01
Stg#3	1.52	11.7	95.	14.0	14.74	16.60	16.48	0.89	1.01
Stg#4	1.52	11.7	95.	9.0	9.47	12.05	11.96	0.79	1.01

RUN 2	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2

	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.16	15.0	84.	34.0	40.48	27.69	31.96	1.27	0.87
Stg#2	1.16	15.0	84.	17.0	20.24	20.11	23.21	0.87	0.87
Stg#3	1.16	15.0	84.	8.0	9.52	14.60	16.85	0.57	0.87
Stg#4	1.16	15.0	84.	6.0	7.14	10.60	12.24	0.58	0.87

RUN 3	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.03	22.8	72.	24.0	33.33	25.96	32.01	1.04	0.81
Stg#2	1.03	22.8	72.	12.0	16.67	18.85	23.25	0.72	0.81
Stg#3	1.03	22.8	72.	6.0	8.33	13.69	16.88	0.49	0.81
Stg#4	1.03	22.8	72.	5.0	6.94	9.94	12.26	0.57	0.81

RUN 4	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.03	17.8	39.	12.0	30.77	41.97	51.76	0.59	0.81
Stg#2	1.03	17.8	39.	8.0	20.51	30.48	37.59	0.55	0.81
Stg#3	1.03	17.8	39.	6.0	15.38	22.13	27.29	0.56	0.81
Stg#4	1.03	17.8	39.	6.0	15.38	16.07	19.82	0.78	0.81

RUN 5	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	1.01	18.9	78.	36.0	46.15	25.46	31.75	1.45	0.80
Stg#2	1.01	18.9	78.	16.0	20.51	18.49	23.06	0.89	0.80
Stg#3	1.01	18.9	78.	8.0	10.26	13.43	16.74	0.61	0.80
Stg#4	1.01	18.9	78.	6.0	7.69	9.75	12.16	0.63	0.80

RUN 6	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	2.23	18.3	58.	43.0	74.14	48.90	39.19	1.89	1.25
Stg#2	2.23	18.3	58.	24.0	41.38	35.51	28.46	1.45	1.25
Stg#3	2.23	18.3	58.	15.0	25.86	25.78	20.67	1.25	1.25
Stg#4	2.23	18.3	58.	10.0	17.24	18.72	15.01	1.15	1.25

RUN 7	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	2.12	17.2	51.	35.0	68.63	52.71	43.46	1.58	1.21
Stg#2	2.12	17.2	51.	24.0	47.06	38.27	31.56	1.49	1.21
Stg#3	2.12	17.2	51.	16.0	31.37	27.79	22.91	1.37	1.21
Stg#4	2.12	17.2	51.	11.0	21.57	20.18	16.64	1.30	1.21

RUN 8	HL	TMP	INFL	EFFL	RM1%	RM2%	REF%	P1	P2
Stg#1	2.17	12.3	78.	56.0	71.79	43.39	35.32	2.03	1.23
Stg#2	2.17	12.3	78.	34.0	43.59	31.51	25.64	1.70	1.23
Stg#3	2.17	12.3	78.	25.0	32.05	22.88	18.62	1.72	1.23
Stg#4	2.17	12.3	78.	13.0	16.67	16.62	13.52	1.23	1.23

APPENDIX C. OUTPUT DATA OF PROTOTYPE SCALE-UP FACTORS

Scale-up factor of RBC PROTOTYPE plants

curve # 1 --> a= -29.18055 b= 0.86580 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	15	2	0.0400	3.395	1.2599
6.	4000.	15	2	0.0278	2.358	1.2735
7.	4000.	15	2	0.0204	1.732	1.2775
8.	4000.	15	2	0.0156	1.326	1.2784
9.	4000.	15	2	0.0123	1.048	1.2782
10.	4000.	15	2	0.0100	0.849	1.2777

curve # 2 --> a= -12.96913 b= 0.57720 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	15	3	0.0400	2.264	1.2743
6.	4000.	15	3	0.0278	1.572	1.2780
7.	4000.	15	3	0.0204	1.155	1.2784
8.	4000.	15	3	0.0156	0.884	1.2779
9.	4000.	15	3	0.0123	0.699	1.2771
10.	4000.	15	3	0.0100	0.566	1.2765

curve # 3 --> a= -7.29514 b= 0.43290 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	15	4	0.0400	1.698	1.2776
6.	4000.	15	4	0.0278	1.179	1.2784
7.	4000.	15	4	0.0204	0.866	1.2778
8.	4000.	15	4	0.0156	0.663	1.2770
9.	4000.	15	4	0.0123	0.524	1.2762
10.	4000.	15	4	0.0100	0.424	1.2756

curve # 4 --> a= -4.66889 b= 0.34632 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	15	5	0.0400	1.358	1.2784
6.	4000.	15	5	0.0278	0.943	1.2780
7.	4000.	15	5	0.0204	0.693	1.2771
8.	4000.	15	5	0.0156	0.531	1.2763
9.	4000.	15	5	0.0123	0.419	1.2756
10.	4000.	15	5	0.0100	0.340	1.2750

curve # 5 --> a= -10.50500 b= 0.51948 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	25	2	0.0400	2.037	1.2760
6.	4000.	25	2	0.0278	1.415	1.2783
7.	4000.	25	2	0.0204	1.039	1.2782
8.	4000.	25	2	0.0156	0.796	1.2776
9.	4000.	25	2	0.0123	0.629	1.2768
10.	4000.	25	2	0.0100	0.509	1.2761

curve # 6 --> a= -4.66889 b= 0.34632 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	25	3	0.0400	1.358	1.2784
6.	4000.	25	3	0.0278	0.943	1.2780
7.	4000.	25	3	0.0204	0.693	1.2771
8.	4000.	25	3	0.0156	0.531	1.2763
9.	4000.	25	3	0.0123	0.419	1.2756
10.	4000.	25	3	0.0100	0.340	1.2750

curve # 7 --> a= -2.62625 b= 0.25974 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	25	4	0.0400	1.019	1.2782
6.	4000.	25	4	0.0278	0.707	1.2772
7.	4000.	25	4	0.0204	0.520	1.2762
8.	4000.	25	4	0.0156	0.398	1.2754
9.	4000.	25	4	0.0123	0.314	1.2748
10.	4000.	25	4	0.0100	0.255	1.2743

curve # 8 --> a= -1.68080 b= 0.20779 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	25	5	0.0400	0.815	1.2776
6.	4000.	25	5	0.0278	0.566	1.2765
7.	4000.	25	5	0.0204	0.416	1.2755
8.	4000.	25	5	0.0156	0.318	1.2748
9.	4000.	25	5	0.0123	0.252	1.2743
10.	4000.	25	5	0.0100	0.204	1.2739

curve # 9 --> a= -5.35969 b= 0.37106 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	35	2	0.0400	1.455	1.2783
6.	4000.	35	2	0.0278	1.011	1.2782
7.	4000.	35	2	0.0204	0.742	1.2773
8.	4000.	35	2	0.0156	0.568	1.2765
9.	4000.	35	2	0.0123	0.449	1.2758
10.	4000.	35	2	0.0100	0.364	1.2752

curve #10 --> a= -2.38209 b= 0.24737 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	35	3	0.0400	0.970	1.2781
6.	4000.	35	3	0.0278	0.674	1.2770
7.	4000.	35	3	0.0204	0.495	1.2761
8.	4000.	35	3	0.0156	0.379	1.2753
9.	4000.	35	3	0.0123	0.299	1.2747
10.	4000.	35	3	0.0100	0.243	1.2742

curve #11 --> a= -1.33992 b= 0.18553 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	35	4	0.0400	0.728	1.2773
6.	4000.	35	4	0.0278	0.505	1.2761
7.	4000.	35	4	0.0204	0.371	1.2752
8.	4000.	35	4	0.0156	0.284	1.2746
9.	4000.	35	4	0.0123	0.225	1.2741
10.	4000.	35	4	0.0100	0.182	1.2737

curve #12 --> a= -0.85755 b= 0.14842 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	35	5	0.0400	0.582	1.2766
6.	4000.	35	5	0.0278	0.404	1.2755
7.	4000.	35	5	0.0204	0.297	1.2747
8.	4000.	35	5	0.0156	0.227	1.2741
9.	4000.	35	5	0.0123	0.180	1.2737
10.	4000.	35	5	0.0100	0.146	1.2734

curve #13 --> a= -3.24228 b= 0.28860 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	45	2	0.0400	1.132	1.2784
6.	4000.	45	2	0.0278	0.786	1.2775
7.	4000.	45	2	0.0204	0.577	1.2765
8.	4000.	45	2	0.0156	0.442	1.2757
9.	4000.	45	2	0.0123	0.349	1.2751
10.	4000.	45	2	0.0100	0.283	1.2746

curve #14 --> a= -1.44101 b= 0.19240 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	45	3	0.0400	0.755	1.2774
6.	4000.	45	3	0.0278	0.524	1.2762
7.	4000.	45	3	0.0204	0.385	1.2753
8.	4000.	45	3	0.0156	0.295	1.2747
9.	4000.	45	3	0.0123	0.233	1.2742
10.	4000.	45	3	0.0100	0.189	1.2738

curve #15 --> a= -0.81057 b= 0.14430 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	45	4	0.0400	0.566	1.2765
6.	4000.	45	4	0.0278	0.393	1.2754
7.	4000.	45	4	0.0204	0.289	1.2746
8.	4000.	45	4	0.0156	0.221	1.2741
9.	4000.	45	4	0.0123	0.175	1.2737
10.	4000.	45	4	0.0100	0.141	1.2734

curve #16 --> a= -0.51877 b= 0.11544 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	4000.	45	5	0.0400	0.453	1.2758
6.	4000.	45	5	0.0278	0.314	1.2748
7.	4000.	45	5	0.0204	0.231	1.2741
8.	4000.	45	5	0.0156	0.177	1.2737
9.	4000.	45	5	0.0123	0.140	1.2733
10.	4000.	45	5	0.0100	0.113	1.2731

curve #17 --> a=-116.72220 b= 1.73161 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	15	2	0.0400	6.791	1.1545
6.	8000.	15	2	0.0278	4.716	1.2300
7.	8000.	15	2	0.0204	3.465	1.2587

8.	8000.	15	2	0.0156	2.653	1.2706
9.	8000.	15	2	0.0123	2.096	1.2756
10.	8000.	15	2	0.0100	1.698	1.2776

curve #18 --> a= -51.87653 b= 1.15440 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	15	3	0.0400	4.527	1.2352
6.	8000.	15	3	0.0278	3.144	1.2640
7.	8000.	15	3	0.0204	2.310	1.2740
8.	8000.	15	3	0.0156	1.768	1.2774
9.	8000.	15	3	0.0123	1.397	1.2783
10.	8000.	15	3	0.0100	1.132	1.2784

curve #19 --> a= -29.18055 b= 0.86580 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	15	4	0.0400	3.395	1.2599
6.	8000.	15	4	0.0278	2.358	1.2735
7.	8000.	15	4	0.0204	1.732	1.2775
8.	8000.	15	4	0.0156	1.326	1.2784
9.	8000.	15	4	0.0123	1.048	1.2782
10.	8000.	15	4	0.0100	0.849	1.2777

curve #20 --> a= -18.67555 b= 0.69264 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	15	5	0.0400	2.716	1.2698
6.	8000.	15	5	0.0278	1.886	1.2768
7.	8000.	15	5	0.0204	1.386	1.2784
8.	8000.	15	5	0.0156	1.061	1.2783
9.	8000.	15	5	0.0123	0.838	1.2777
10.	8000.	15	5	0.0100	0.679	1.2771

curve #21 --> a= -42.01999 b= 1.03896 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	25	2	0.0400	4.074	1.2463
6.	8000.	25	2	0.0278	2.829	1.2684
7.	8000.	25	2	0.0204	2.079	1.2757
8.	8000.	25	2	0.0156	1.592	1.2780
9.	8000.	25	2	0.0123	1.258	1.2784
10.	8000.	25	2	0.0100	1.019	1.2782

curve #22 --> a= -18.67555 b= 0.69264 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	25	3	0.0400	2.716	1.2698
6.	8000.	25	3	0.0278	1.886	1.2768
7.	8000.	25	3	0.0204	1.386	1.2784
8.	8000.	25	3	0.0156	1.061	1.2783
9.	8000.	25	3	0.0123	0.838	1.2777
10.	8000.	25	3	0.0100	0.679	1.2771

curve #23 --> a= -10.50500 b= 0.51948 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF

5.	8000.	25	4	0.0400	2.037	1.2760
6.	8000.	25	4	0.0278	1.415	1.2783
7.	8000.	25	4	0.0204	1.039	1.2782
8.	8000.	25	4	0.0156	0.796	1.2776
9.	8000.	25	4	0.0123	0.629	1.2768
10.	8000.	25	4	0.0100	0.509	1.2761

curve #24 --> a= -6.72320 b= 0.41559 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	25	5	0.0400	1.630	1.2779
6.	8000.	25	5	0.0278	1.132	1.2784
7.	8000.	25	5	0.0204	0.832	1.2777
8.	8000.	25	5	0.0156	0.637	1.2769
9.	8000.	25	5	0.0123	0.503	1.2761
10.	8000.	25	5	0.0100	0.407	1.2755

curve #25 --> a= -21.43877 b= 0.74212 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	35	2	0.0400	2.910	1.2674
6.	8000.	35	2	0.0278	2.021	1.2761
7.	8000.	35	2	0.0204	1.485	1.2782
8.	8000.	35	2	0.0156	1.137	1.2784
9.	8000.	35	2	0.0123	0.898	1.2779
10.	8000.	35	2	0.0100	0.728	1.2773

curve #26 --> a= -9.52834 b= 0.49474 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	35	3	0.0400	1.940	1.2765
6.	8000.	35	3	0.0278	1.347	1.2784
7.	8000.	35	3	0.0204	0.990	1.2781
8.	8000.	35	3	0.0156	0.758	1.2774
9.	8000.	35	3	0.0123	0.599	1.2767
10.	8000.	35	3	0.0100	0.485	1.2760

curve #27 --> a= -5.35969 b= 0.37106 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	35	4	0.0400	1.455	1.2783
6.	8000.	35	4	0.0278	1.011	1.2782
7.	8000.	35	4	0.0204	0.742	1.2773
8.	8000.	35	4	0.0156	0.568	1.2765
9.	8000.	35	4	0.0123	0.449	1.2758
10.	8000.	35	4	0.0100	0.364	1.2752

curve #28 --> a= -3.43020 b= 0.29685 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	35	5	0.0400	1.164	1.2784
6.	8000.	35	5	0.0278	0.808	1.2776
7.	8000.	35	5	0.0204	0.594	1.2766
8.	8000.	35	5	0.0156	0.455	1.2758
9.	8000.	35	5	0.0123	0.359	1.2751
10.	8000.	35	5	0.0100	0.291	1.2746

curve #29 --> a= -12.96913 b= 0.57720 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	45	2	0.0400	2.264	1.2743
6.	8000.	45	2	0.0278	1.572	1.2780
7.	8000.	45	2	0.0204	1.155	1.2784
8.	8000.	45	2	0.0156	0.884	1.2779
9.	8000.	45	2	0.0123	0.699	1.2771
10.	8000.	45	2	0.0100	0.566	1.2765

curve #30 --> a= -5.76406 b= 0.38480 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	45	3	0.0400	1.509	1.2782
6.	8000.	45	3	0.0278	1.048	1.2782
7.	8000.	45	3	0.0204	0.770	1.2775
8.	8000.	45	3	0.0156	0.589	1.2766
9.	8000.	45	3	0.0123	0.466	1.2759
10.	8000.	45	3	0.0100	0.377	1.2753

curve #31 --> a= -3.24228 b= 0.28860 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	45	4	0.0400	1.132	1.2784
6.	8000.	45	4	0.0278	0.786	1.2775
7.	8000.	45	4	0.0204	0.577	1.2765
8.	8000.	45	4	0.0156	0.442	1.2757
9.	8000.	45	4	0.0123	0.349	1.2751
10.	8000.	45	4	0.0100	0.283	1.2746

curve #32 --> a= -2.07506 b= 0.23088 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	8000.	45	5	0.0400	0.905	1.2779
6.	8000.	45	5	0.0278	0.629	1.2768
7.	8000.	45	5	0.0204	0.462	1.2758
8.	8000.	45	5	0.0156	0.354	1.2751
9.	8000.	45	5	0.0123	0.279	1.2745
10.	8000.	45	5	0.0100	0.226	1.2741

curve #33 --> a=-116.72220 b= 1.73161 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	15	3	0.0400	6.791	1.1545
6.	12000.	15	3	0.0278	4.716	1.2300
7.	12000.	15	3	0.0204	3.465	1.2587
8.	12000.	15	3	0.0156	2.653	1.2706
9.	12000.	15	3	0.0123	2.096	1.2756
10.	12000.	15	3	0.0100	1.698	1.2776

curve #34 --> a= -65.65623 b= 1.29871 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	15	4	0.0400	5.093	1.2189
6.	12000.	15	4	0.0278	3.537	1.2574
7.	12000.	15	4	0.0204	2.598	1.2712
8.	12000.	15	4	0.0156	1.989	1.2763

9.	12000.	15	4	0.0123	1.572	1.2780
10.	12000.	15	4	0.0100	1.273	1.2784

curve #35 --> a= -42.01999 b= 1.03896 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	15	5	0.0400	4.074	1.2463
6.	12000.	15	5	0.0278	2.829	1.2684
7.	12000.	15	5	0.0204	2.079	1.2757
8.	12000.	15	5	0.0156	1.592	1.2780
9.	12000.	15	5	0.0123	1.258	1.2784
10.	12000.	15	5	0.0100	1.019	1.2782

curve #36 --> a= -94.54498 b= 1.55845 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	25	2	0.0400	6.112	1.1831
6.	12000.	25	2	0.0278	4.244	1.2423
7.	12000.	25	2	0.0204	3.118	1.2644
8.	12000.	25	2	0.0156	2.387	1.2733
9.	12000.	25	2	0.0123	1.886	1.2768
10.	12000.	25	2	0.0100	1.528	1.2781

curve #37 --> a= -42.01999 b= 1.03896 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	25	3	0.0400	4.074	1.2463
6.	12000.	25	3	0.0278	2.829	1.2684
7.	12000.	25	3	0.0204	2.079	1.2757
8.	12000.	25	3	0.0156	1.592	1.2780
9.	12000.	25	3	0.0123	1.258	1.2784
10.	12000.	25	3	0.0100	1.019	1.2782

curve #38 --> a= -23.63624 b= 0.77922 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	25	4	0.0400	3.056	1.2654
6.	12000.	25	4	0.0278	2.122	1.2754
7.	12000.	25	4	0.0204	1.559	1.2781
8.	12000.	25	4	0.0156	1.194	1.2784
9.	12000.	25	4	0.0123	0.943	1.2780
10.	12000.	25	4	0.0100	0.764	1.2774

curve #39 --> a= -15.12720 b= 0.62338 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	25	5	0.0400	2.445	1.2727
6.	12000.	25	5	0.0278	1.698	1.2776
7.	12000.	25	5	0.0204	1.247	1.2784
8.	12000.	25	5	0.0156	0.955	1.2780
9.	12000.	25	5	0.0123	0.755	1.2774
10.	12000.	25	5	0.0100	0.611	1.2767

curve #40 --> a= -48.23723 b= 1.11318 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	35	2	0.0400	4.365	1.2393

6.	12000.	35	2	0.0278	3.032	1.2657
7.	12000.	35	2	0.0204	2.227	1.2746
8.	12000.	35	2	0.0156	1.705	1.2776
9.	12000.	35	2	0.0123	1.347	1.2784
10.	12000.	35	2	0.0100	1.091	1.2783

curve #41 --> a= -21.43877 b= 0.74212 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	35	3	0.0400	2.910	1.2674
6.	12000.	35	3	0.0278	2.021	1.2761
7.	12000.	35	3	0.0204	1.485	1.2782
8.	12000.	35	3	0.0156	1.137	1.2784
9.	12000.	35	3	0.0123	0.898	1.2779
10.	12000.	35	3	0.0100	0.728	1.2773

curve #42 --> a= -12.05931 b= 0.55659 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	35	4	0.0400	2.183	1.2750
6.	12000.	35	4	0.0278	1.516	1.2782
7.	12000.	35	4	0.0204	1.114	1.2783
8.	12000.	35	4	0.0156	0.853	1.2778
9.	12000.	35	4	0.0123	0.674	1.2770
10.	12000.	35	4	0.0100	0.546	1.2764

curve #43 --> a= -7.71796 b= 0.44527 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	35	5	0.0400	1.746	1.2775
6.	12000.	35	5	0.0278	1.213	1.2784
7.	12000.	35	5	0.0204	0.891	1.2779
8.	12000.	35	5	0.0156	0.682	1.2771
9.	12000.	35	5	0.0123	0.539	1.2763
10.	12000.	35	5	0.0100	0.437	1.2757

curve #44 --> a= -29.18055 b= 0.86580 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	45	2	0.0400	3.395	1.2599
6.	12000.	45	2	0.0278	2.358	1.2735
7.	12000.	45	2	0.0204	1.732	1.2775
8.	12000.	45	2	0.0156	1.326	1.2784
9.	12000.	45	2	0.0123	1.048	1.2782
10.	12000.	45	2	0.0100	0.849	1.2777

curve #45 --> a= -12.96913 b= 0.57720 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	45	3	0.0400	2.264	1.2743
6.	12000.	45	3	0.0278	1.572	1.2780
7.	12000.	45	3	0.0204	1.155	1.2784
8.	12000.	45	3	0.0156	0.884	1.2779
9.	12000.	45	3	0.0123	0.699	1.2771
10.	12000.	45	3	0.0100	0.566	1.2765

curve #46 --> a= -7.29514 b= 0.43290 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	45	4	0.0400	1.698	1.2776
6.	12000.	45	4	0.0278	1.179	1.2784
7.	12000.	45	4	0.0204	0.866	1.2778
8.	12000.	45	4	0.0156	0.663	1.2770
9.	12000.	45	4	0.0123	0.524	1.2762
10.	12000.	45	4	0.0100	0.424	1.2756

curve #47 --> a= -4.66889 b= 0.34632 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	12000.	45	5	0.0400	1.358	1.2784
6.	12000.	45	5	0.0278	0.943	1.2780
7.	12000.	45	5	0.0204	0.693	1.2771
8.	12000.	45	5	0.0156	0.531	1.2763
9.	12000.	45	5	0.0123	0.419	1.2756
10.	12000.	45	5	0.0100	0.340	1.2750

curve #48 --> a=-116.72220 b= 1.73161 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	15	4	0.0400	6.791	1.1545
6.	16000.	15	4	0.0278	4.716	1.2300
7.	16000.	15	4	0.0204	3.465	1.2587
8.	16000.	15	4	0.0156	2.653	1.2706
9.	16000.	15	4	0.0123	2.096	1.2756
10.	16000.	15	4	0.0100	1.698	1.2776

curve #49 --> a= -74.70221 b= 1.38529 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	15	5	0.0400	5.432	1.2079
6.	16000.	15	5	0.0278	3.773	1.2528
7.	16000.	15	5	0.0204	2.772	1.2692
8.	16000.	15	5	0.0156	2.122	1.2754
9.	16000.	15	5	0.0123	1.677	1.2777
10.	16000.	15	5	0.0100	1.358	1.2784

curve #50 --> a= -74.70221 b= 1.38529 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	25	3	0.0400	5.432	1.2079
6.	16000.	25	3	0.0278	3.773	1.2528
7.	16000.	25	3	0.0204	2.772	1.2692
8.	16000.	25	3	0.0156	2.122	1.2754
9.	16000.	25	3	0.0123	1.677	1.2777
10.	16000.	25	3	0.0100	1.358	1.2784

curve #51 --> a= -42.01999 b= 1.03896 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	25	4	0.0400	4.074	1.2463
6.	16000.	25	4	0.0278	2.829	1.2684
7.	16000.	25	4	0.0204	2.079	1.2757
8.	16000.	25	4	0.0156	1.592	1.2780
9.	16000.	25	4	0.0123	1.258	1.2784

10.	16000.	25	4	0.0100	1.019	1.2782

curve #52 --> a= -26.89279 b= 0.83117 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	25	5	0.0400	3.259	1.2622
6.	16000.	25	5	0.0278	2.264	1.2743
7.	16000.	25	5	0.0204	1.663	1.2778
8.	16000.	25	5	0.0156	1.273	1.2784
9.	16000.	25	5	0.0123	1.006	1.2782
10.	16000.	25	5	0.0100	0.815	1.2776

curve #53 --> a= -85.75507 b= 1.48423 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	35	2	0.0400	5.821	1.1942
6.	16000.	35	2	0.0278	4.042	1.2471
7.	16000.	35	2	0.0204	2.970	1.2666
8.	16000.	35	2	0.0156	2.274	1.2743
9.	16000.	35	2	0.0123	1.796	1.2773
10.	16000.	35	2	0.0100	1.455	1.2783

curve #54 --> a= -38.11337 b= 0.98949 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	35	3	0.0400	3.880	1.2506
6.	16000.	35	3	0.0278	2.695	1.2701
7.	16000.	35	3	0.0204	1.980	1.2763
8.	16000.	35	3	0.0156	1.516	1.2782
9.	16000.	35	3	0.0123	1.198	1.2784
10.	16000.	35	3	0.0100	0.970	1.2781

curve #55 --> a= -21.43877 b= 0.74212 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	35	4	0.0400	2.910	1.2674
6.	16000.	35	4	0.0278	2.021	1.2761
7.	16000.	35	4	0.0204	1.485	1.2782
8.	16000.	35	4	0.0156	1.137	1.2784
9.	16000.	35	4	0.0123	0.898	1.2779
10.	16000.	35	4	0.0100	0.728	1.2773

curve #56 --> a= -13.72081 b= 0.59369 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	35	5	0.0400	2.328	1.2738
6.	16000.	35	5	0.0278	1.617	1.2779
7.	16000.	35	5	0.0204	1.188	1.2784
8.	16000.	35	5	0.0156	0.909	1.2779
9.	16000.	35	5	0.0123	0.719	1.2772
10.	16000.	35	5	0.0100	0.582	1.2766

curve #57 --> a= -51.87653 b= 1.15440 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	45	2	0.0400	4.527	1.2352
6.	16000.	45	2	0.0278	3.144	1.2640

7.	16000.	45	2	0.0204	2.310	1.2740
8.	16000.	45	2	0.0156	1.768	1.2774
9.	16000.	45	2	0.0123	1.397	1.2783
10.	16000.	45	2	0.0100	1.132	1.2784

curve #58 --> a= -23.05624 b= 0.76960 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	45	3	0.0400	3.018	1.2659
6.	16000.	45	3	0.0278	2.096	1.2756
7.	16000.	45	3	0.0204	1.540	1.2781
8.	16000.	45	3	0.0156	1.179	1.2784
9.	16000.	45	3	0.0123	0.931	1.2780
10.	16000.	45	3	0.0100	0.755	1.2774

curve #59 --> a= -12.96913 b= 0.57720 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	45	4	0.0400	2.264	1.2743
6.	16000.	45	4	0.0278	1.572	1.2780
7.	16000.	45	4	0.0204	1.155	1.2784
8.	16000.	45	4	0.0156	0.884	1.2779
9.	16000.	45	4	0.0123	0.699	1.2771
10.	16000.	45	4	0.0100	0.566	1.2765

curve #60 --> a= -8.30025 b= 0.46176 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	16000.	45	5	0.0400	1.811	1.2772
6.	16000.	45	5	0.0278	1.258	1.2784
7.	16000.	45	5	0.0204	0.924	1.2780
8.	16000.	45	5	0.0156	0.707	1.2772
9.	16000.	45	5	0.0123	0.559	1.2764
10.	16000.	45	5	0.0100	0.453	1.2758

curve #61 --> a=-116.72220 b= 1.73161 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	15	5	0.0400	6.791	1.1545
6.	20000.	15	5	0.0278	4.716	1.2300
7.	20000.	15	5	0.0204	3.465	1.2587
8.	20000.	15	5	0.0156	2.653	1.2706
9.	20000.	15	5	0.0123	2.096	1.2756
10.	20000.	15	5	0.0100	1.698	1.2776

curve #62 --> a=-116.72220 b= 1.73161 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	25	3	0.0400	6.791	1.1545
6.	20000.	25	3	0.0278	4.716	1.2300
7.	20000.	25	3	0.0204	3.465	1.2587
8.	20000.	25	3	0.0156	2.653	1.2706
9.	20000.	25	3	0.0123	2.096	1.2756
10.	20000.	25	3	0.0100	1.698	1.2776

curve #63 --> a= -65.65623 b= 1.29871 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	25	4	0.0400	5.093	1.2189
6.	20000.	25	4	0.0278	3.537	1.2574
7.	20000.	25	4	0.0204	2.598	1.2712
8.	20000.	25	4	0.0156	1.989	1.2763
9.	20000.	25	4	0.0123	1.572	1.2780
10.	20000.	25	4	0.0100	1.273	1.2784

curve #64 --> a= -42.01999 b= 1.03896 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	25	5	0.0400	4.074	1.2463
6.	20000.	25	5	0.0278	2.829	1.2684
7.	20000.	25	5	0.0204	2.079	1.2757
8.	20000.	25	5	0.0156	1.592	1.2780
9.	20000.	25	5	0.0123	1.258	1.2784
10.	20000.	25	5	0.0100	1.019	1.2782

curve #65 --> a= -59.55214 b= 1.23686 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	35	3	0.0400	4.850	1.2262
6.	20000.	35	3	0.0278	3.368	1.2604
7.	20000.	35	3	0.0204	2.475	1.2724
8.	20000.	35	3	0.0156	1.895	1.2768
9.	20000.	35	3	0.0123	1.497	1.2782
10.	20000.	35	3	0.0100	1.213	1.2784

curve #66 --> a= -33.49808 b= 0.92765 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	35	4	0.0400	3.638	1.2555
6.	20000.	35	4	0.0278	2.526	1.2719
7.	20000.	35	4	0.0204	1.856	1.2770
8.	20000.	35	4	0.0156	1.421	1.2783
9.	20000.	35	4	0.0123	1.123	1.2783
10.	20000.	35	4	0.0100	0.909	1.2779

curve #67 --> a= -21.43877 b= 0.74212 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	35	5	0.0400	2.910	1.2674
6.	20000.	35	5	0.0278	2.021	1.2761
7.	20000.	35	5	0.0204	1.485	1.2782
8.	20000.	35	5	0.0156	1.137	1.2784
9.	20000.	35	5	0.0123	0.898	1.2779
10.	20000.	35	5	0.0100	0.728	1.2773

curve #68 --> a= -81.05708 b= 1.44301 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	45	2	0.0400	5.659	1.2000
6.	20000.	45	2	0.0278	3.930	1.2495
7.	20000.	45	2	0.0204	2.887	1.2677
8.	20000.	45	2	0.0156	2.210	1.2748
9.	20000.	45	2	0.0123	1.747	1.2775
10.	20000.	45	2	0.0100	1.415	1.2783

curve #69 --> a= -36.02537 b= 0.96200 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	45	3	0.0400	3.773	1.2528
6.	20000.	45	3	0.0278	2.620	1.2709
7.	20000.	45	3	0.0204	1.925	1.2766
8.	20000.	45	3	0.0156	1.474	1.2782
9.	20000.	45	3	0.0123	1.164	1.2784
10.	20000.	45	3	0.0100	0.943	1.2780

curve #70 --> a= -20.26427 b= 0.72150 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	20000.	45	4	0.0400	2.829	1.2684
6.	20000.	45	4	0.0278	1.965	1.2764
7.	20000.	45	4	0.0204	1.444	1.2783
8.	20000.	45	4	0.0156	1.105	1.2783
9.	20000.	45	4	0.0123	0.873	1.2778
10.	20000.	45	4	0.0100	0.707	1.2772

curve #71 --> a= -12.96913 b= 0.57720 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF

5.	20000.	45	5	0.0400	2.264	1.2743
6.	20000.	45	5	0.0278	1.572	1.2780
7.	20000.	45	5	0.0204	1.155	1.2784
8.	20000.	45	5	0.0156	0.884	1.2779
9.	20000.	45	5	0.0123	0.699	1.2771
10.	20000.	45	5	0.0100	0.566	1.2765

curve #72 --> a= -94.54498 b= 1.55845 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	25	4	0.0400	6.112	1.1831
6.	24000.	25	4	0.0278	4.244	1.2423
7.	24000.	25	4	0.0204	3.118	1.2644
8.	24000.	25	4	0.0156	2.387	1.2733
9.	24000.	25	4	0.0123	1.886	1.2768
10.	24000.	25	4	0.0100	1.528	1.2781

curve #73 --> a= -60.50879 b= 1.24676 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	25	5	0.0400	4.889	1.2251
6.	24000.	25	5	0.0278	3.395	1.2599
7.	24000.	25	5	0.0204	2.495	1.2722
8.	24000.	25	5	0.0156	1.910	1.2767
9.	24000.	25	5	0.0123	1.509	1.2782
10.	24000.	25	5	0.0100	1.222	1.2784

curve #74 --> a= -85.75507 b= 1.48423 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	35	3	0.0400	5.821	1.1942
6.	24000.	35	3	0.0278	4.042	1.2471
7.	24000.	35	3	0.0204	2.970	1.2666
8.	24000.	35	3	0.0156	2.274	1.2743
9.	24000.	35	3	0.0123	1.796	1.2773
10.	24000.	35	3	0.0100	1.455	1.2783

curve #75 --> a= -48.23723 b= 1.11318 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	35	4	0.0400	4.365	1.2393
6.	24000.	35	4	0.0278	3.032	1.2657
7.	24000.	35	4	0.0204	2.227	1.2746
8.	24000.	35	4	0.0156	1.705	1.2776
9.	24000.	35	4	0.0123	1.347	1.2784
10.	24000.	35	4	0.0100	1.091	1.2783

curve #76 --> a= -30.87183 b= 0.89054 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	35	5	0.0400	3.492	1.2582
6.	24000.	35	5	0.0278	2.425	1.2729
7.	24000.	35	5	0.0204	1.782	1.2773
8.	24000.	35	5	0.0156	1.364	1.2784
9.	24000.	35	5	0.0123	1.078	1.2783
10.	24000.	35	5	0.0100	0.873	1.2778

curve #77 --> a=-116.72220 b= 1.73161 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	45	2	0.0400	6.791	1.1545
6.	24000.	45	2	0.0278	4.716	1.2300
7.	24000.	45	2	0.0204	3.465	1.2587
8.	24000.	45	2	0.0156	2.653	1.2706
9.	24000.	45	2	0.0123	2.096	1.2756
10.	24000.	45	2	0.0100	1.698	1.2776

curve #78 --> a= -51.87653 b= 1.15440 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	45	3	0.0400	4.527	1.2352
6.	24000.	45	3	0.0278	3.144	1.2640
7.	24000.	45	3	0.0204	2.310	1.2740
8.	24000.	45	3	0.0156	1.768	1.2774
9.	24000.	45	3	0.0123	1.397	1.2783
10.	24000.	45	3	0.0100	1.132	1.2784

curve #79 --> a= -29.18055 b= 0.86580 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	45	4	0.0400	3.395	1.2599
6.	24000.	45	4	0.0278	2.358	1.2735
7.	24000.	45	4	0.0204	1.732	1.2775
8.	24000.	45	4	0.0156	1.326	1.2784
9.	24000.	45	4	0.0123	1.048	1.2782
10.	24000.	45	4	0.0100	0.849	1.2777

curve #80 --> a= -18.67555 b= 0.69264 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	24000.	45	5	0.0400	2.716	1.2698
6.	24000.	45	5	0.0278	1.886	1.2768
7.	24000.	45	5	0.0204	1.386	1.2784
8.	24000.	45	5	0.0156	1.061	1.2783
9.	24000.	45	5	0.0123	0.838	1.2777
10.	24000.	45	5	0.0100	0.679	1.2771

curve #81 --> a= -82.35919 b= 1.45455 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	28000.	25	5	0.0400	5.704	1.1984
6.	28000.	25	5	0.0278	3.961	1.2489
7.	28000.	25	5	0.0204	2.910	1.2674
8.	28000.	25	5	0.0156	2.228	1.2746
9.	28000.	25	5	0.0123	1.761	1.2774
10.	28000.	25	5	0.0100	1.426	1.2783

curve #82 --> a=-116.72218 b= 1.73161 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	28000.	35	3	0.0400	6.791	1.1545
6.	28000.	35	3	0.0278	4.716	1.2300
7.	28000.	35	3	0.0204	3.465	1.2587
8.	28000.	35	3	0.0156	2.653	1.2706

9.	28000.	35	3	0.0123	2.096	1.2756
10.	28000.	35	3	0.0100	1.698	1.2776

curve #83 --> a= -65.65623 b= 1.29871 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	28000.	35	4	0.0400	5.093	1.2189
6.	28000.	35	4	0.0278	3.537	1.2574
7.	28000.	35	4	0.0204	2.598	1.2712
8.	28000.	35	4	0.0156	1.989	1.2763
9.	28000.	35	4	0.0123	1.572	1.2780
10.	28000.	35	4	0.0100	1.273	1.2784

curve #84 --> a= -42.01999 b= 1.03896 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	28000.	35	5	0.0400	4.074	1.2463
6.	28000.	35	5	0.0278	2.829	1.2684
7.	28000.	35	5	0.0204	2.079	1.2757
8.	28000.	35	5	0.0156	1.592	1.2780
9.	28000.	35	5	0.0123	1.258	1.2784
10.	28000.	35	5	0.0100	1.019	1.2782

curve #85 --> a= -70.60973 b= 1.34681 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	28000.	45	3	0.0400	5.282	1.2129
6.	28000.	45	3	0.0278	3.668	1.2549
7.	28000.	45	3	0.0204	2.695	1.2701
8.	28000.	45	3	0.0156	2.063	1.2758
9.	28000.	45	3	0.0123	1.630	1.2779
10.	28000.	45	3	0.0100	1.320	1.2784

curve #86 --> a= -39.71797 b= 1.01010 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	28000.	45	4	0.0400	3.961	1.2489
6.	28000.	45	4	0.0278	2.751	1.2694
7.	28000.	45	4	0.0204	2.021	1.2761
8.	28000.	45	4	0.0156	1.547	1.2781
9.	28000.	45	4	0.0123	1.223	1.2784
10.	28000.	45	4	0.0100	0.990	1.2781

curve #87 --> a= -25.41950 b= 0.80808 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	28000.	45	5	0.0400	3.169	1.2637
6.	28000.	45	5	0.0278	2.201	1.2748
7.	28000.	45	5	0.0204	1.617	1.2779
8.	28000.	45	5	0.0156	1.238	1.2784
9.	28000.	45	5	0.0123	0.978	1.2781
10.	28000.	45	5	0.0100	0.792	1.2775

curve #88 --> a=-107.57117 b= 1.66234 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	32000.	25	5	0.0400	6.519	1.1664

6.	32000.	25	5	0.0278	4.527	1.2352
7.	32000.	25	5	0.0204	3.326	1.2611
8.	32000.	25	5	0.0156	2.546	1.2717
9.	32000.	25	5	0.0123	2.012	1.2761
10.	32000.	25	5	0.0100	1.630	1.2779

curve #89 --> a= -85.75507 b= 1.48423 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	32000.	35	4	0.0400	5.821	1.1942
6.	32000.	35	4	0.0278	4.042	1.2471
7.	32000.	35	4	0.0204	2.970	1.2666
8.	32000.	35	4	0.0156	2.274	1.2743
9.	32000.	35	4	0.0123	1.796	1.2773
10.	32000.	35	4	0.0100	1.455	1.2783

curve #90 --> a= -54.88325 b= 1.18739 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	32000.	35	5	0.0400	4.656	1.2317
6.	32000.	35	5	0.0278	3.234	1.2626
7.	32000.	35	5	0.0204	2.376	1.2734
8.	32000.	35	5	0.0156	1.819	1.2772
9.	32000.	35	5	0.0123	1.437	1.2783
10.	32000.	35	5	0.0100	1.164	1.2784

curve #91 --> a= -92.22495 b= 1.53921 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	32000.	45	3	0.0400	6.036	1.1860
6.	32000.	45	3	0.0278	4.192	1.2436
7.	32000.	45	3	0.0204	3.080	1.2650
8.	32000.	45	3	0.0156	2.358	1.2735
9.	32000.	45	3	0.0123	1.863	1.2769
10.	32000.	45	3	0.0100	1.509	1.2782

curve #92 --> a= -51.87653 b= 1.15440 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	32000.	45	4	0.0400	4.527	1.2352
6.	32000.	45	4	0.0278	3.144	1.2640
7.	32000.	45	4	0.0204	2.310	1.2740
8.	32000.	45	4	0.0156	1.768	1.2774
9.	32000.	45	4	0.0123	1.397	1.2783
10.	32000.	45	4	0.0100	1.132	1.2784

curve #93 --> a= -33.20098 b= 0.92352 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	32000.	45	5	0.0400	3.622	1.2558
6.	32000.	45	5	0.0278	2.515	1.2720
7.	32000.	45	5	0.0204	1.848	1.2770
8.	32000.	45	5	0.0156	1.415	1.2783
9.	32000.	45	5	0.0123	1.118	1.2783
10.	32000.	45	5	0.0100	0.905	1.2779

curve #94 --> a=-108.53376 b= 1.66976 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	36000.	35	4	0.0400	6.548	1.1651
6.	36000.	35	4	0.0278	4.547	1.2346
7.	36000.	35	4	0.0204	3.341	1.2609
8.	36000.	35	4	0.0156	2.558	1.2716
9.	36000.	35	4	0.0123	2.021	1.2761
10.	36000.	35	4	0.0100	1.637	1.2778

curve #95 --> a= -69.46162 b= 1.33581 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	36000.	35	5	0.0400	5.238	1.2143
6.	36000.	35	5	0.0278	3.638	1.2555
7.	36000.	35	5	0.0204	2.673	1.2703
8.	36000.	35	5	0.0156	2.046	1.2759
9.	36000.	35	5	0.0123	1.617	1.2779
10.	36000.	35	5	0.0100	1.310	1.2784

curve #96 --> a=-116.72220 b= 1.73161 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	36000.	45	3	0.0400	6.791	1.1545
6.	36000.	45	3	0.0278	4.716	1.2300
7.	36000.	45	3	0.0204	3.465	1.2587
8.	36000.	45	3	0.0156	2.653	1.2706
9.	36000.	45	3	0.0123	2.096	1.2756
10.	36000.	45	3	0.0100	1.698	1.2776

curve #97 --> a= -65.65623 b= 1.29871 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	36000.	45	4	0.0400	5.093	1.2189
6.	36000.	45	4	0.0278	3.537	1.2574
7.	36000.	45	4	0.0204	2.598	1.2712
8.	36000.	45	4	0.0156	1.989	1.2763
9.	36000.	45	4	0.0123	1.572	1.2780
10.	36000.	45	4	0.0100	1.273	1.2784

curve #98 --> a= -42.01999 b= 1.03896 c= 1.2720

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
5.	36000.	45	5	0.0400	4.074	1.2463
6.	36000.	45	5	0.0278	2.829	1.2684
7.	36000.	45	5	0.0204	2.079	1.2757
8.	36000.	45	5	0.0156	1.592	1.2780
9.	36000.	45	5	0.0123	1.258	1.2784
10.	36000.	45	5	0.0100	1.019	1.2782

APPENDIX D. OUTPUT DATA OF SMALL-SCALE SCALE-UP FACTORS

Scale-up Factor of SMALL scale RBC plants

curve # 1 --> a= 0.83759 b=-1.76004 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	15	2	1.0000	4.244	1.423
2.0	200.	15	2	0.2500	1.061	1.957
3.0	200.	15	2	0.1111	0.472	2.160
4.0	200.	15	2	0.0625	0.265	2.238

curve # 2 --> a= 0.37226 b=-1.17336 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	15	3	1.0000	2.829	1.544
2.0	200.	15	3	0.2500	0.707	2.075
3.0	200.	15	3	0.1111	0.314	2.219
4.0	200.	15	3	0.0625	0.177	2.273

curve # 3 --> a= 0.20940 b=-0.88002 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	15	4	1.0000	2.122	1.674
2.0	200.	15	4	0.2500	0.531	2.138
3.0	200.	15	4	0.1111	0.236	2.250
4.0	200.	15	4	0.0625	0.133	2.291

curve # 4 --> a= 0.13401 b=-0.70402 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	15	5	1.0000	1.698	1.775
2.0	200.	15	5	0.2500	0.424	2.177
3.0	200.	15	5	0.1111	0.189	2.268
4.0	200.	15	5	0.0625	0.106	2.302

curve # 5 --> a= 0.30153 b=-1.05603 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	25	2	1.0000	2.546	1.591
2.0	200.	25	2	0.2500	0.637	2.100
3.0	200.	25	2	0.1111	0.283	2.231
4.0	200.	25	2	0.0625	0.159	2.280

curve # 6 --> a= 0.13401 b=-0.70402 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	25	3	1.0000	1.698	1.775
2.0	200.	25	3	0.2500	0.424	2.177
3.0	200.	25	3	0.1111	0.189	2.268
4.0	200.	25	3	0.0625	0.106	2.302

curve # 7 --> a= 0.07538 b=-0.52801 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF

1.0	200.	25	4	1.0000	1.273	1.892
2.0	200.	25	4	0.2500	0.318	2.218
3.0	200.	25	4	0.1111	0.141	2.287
4.0	200.	25	4	0.0625	0.080	2.312

curve # 8 --> a= 0.04825 b=-0.42241 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	25	5	1.0000	1.019	1.971
2.0	200.	25	5	0.2500	0.255	2.242
3.0	200.	25	5	0.1111	0.113	2.299
4.0	200.	25	5	0.0625	0.064	2.319

curve # 9 --> a= 0.15384 b=-0.75430 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	35	2	1.0000	1.819	1.745
2.0	200.	35	2	0.2500	0.455	2.166
3.0	200.	35	2	0.1111	0.202	2.263
4.0	200.	35	2	0.0625	0.114	2.298

curve #10 --> a= 0.06837 b=-0.50287 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	35	3	1.0000	1.213	1.911
2.0	200.	35	3	0.2500	0.303	2.224
3.0	200.	35	3	0.1111	0.135	2.290
4.0	200.	35	3	0.0625	0.076	2.314

curve #11 --> a= 0.03846 b=-0.37715 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	35	4	1.0000	0.909	2.006
2.0	200.	35	4	0.2500	0.227	2.253
3.0	200.	35	4	0.1111	0.101	2.304
4.0	200.	35	4	0.0625	0.057	2.322

curve #12 --> a= 0.02461 b=-0.30172 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	35	5	1.0000	0.728	2.068
2.0	200.	35	5	0.2500	0.182	2.271
3.0	200.	35	5	0.1111	0.081	2.312
4.0	200.	35	5	0.0625	0.045	2.326

curve #13 --> a= 0.09307 b=-0.58668 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	45	2	1.0000	1.415	1.851
2.0	200.	45	2	0.2500	0.354	2.204
3.0	200.	45	2	0.1111	0.157	2.281
4.0	200.	45	2	0.0625	0.088	2.309

curve #14 --> a= 0.04136 b=-0.39112 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	45	3	1.0000	0.943	1.995

2.0	200.	45	3	0.2500	0.236	2.250
3.0	200.	45	3	0.1111	0.105	2.302
4.0	200.	45	3	0.0625	0.059	2.321

curve #15 --> a= 0.02327 b=-0.29334 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	45	4	1.0000	0.707	2.075
2.0	200.	45	4	0.2500	0.177	2.273
3.0	200.	45	4	0.1111	0.079	2.313
4.0	200.	45	4	0.0625	0.044	2.327

curve #16 --> a= 0.01489 b=-0.23467 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	45	5	1.0000	0.566	2.125
2.0	200.	45	5	0.2500	0.141	2.287
3.0	200.	45	5	0.1111	0.063	2.319
4.0	200.	45	5	0.0625	0.035	2.330

curve #17 --> a= 1.48905 b=-2.34672 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	15	3	1.0000	5.659	1.487
2.0	400.	15	3	0.2500	1.415	1.851
3.0	400.	15	3	0.1111	0.629	2.103
4.0	400.	15	3	0.0625	0.354	2.204

curve #18 --> a= 0.83759 b=-1.76004 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	15	4	1.0000	4.244	1.423
2.0	400.	15	4	0.2500	1.061	1.957
3.0	400.	15	4	0.1111	0.472	2.160
4.0	400.	15	4	0.0625	0.265	2.238

curve #19 --> a= 0.53606 b=-1.40803 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	15	5	1.0000	3.395	1.473
2.0	400.	15	5	0.2500	0.849	2.026
3.0	400.	15	5	0.1111	0.377	2.195
4.0	400.	15	5	0.0625	0.212	2.259

curve #20 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	25	2	1.0000	5.093	1.439
2.0	400.	25	2	0.2500	1.273	1.892
3.0	400.	25	2	0.1111	0.566	2.125
4.0	400.	25	2	0.0625	0.318	2.218

curve #21 --> a= 0.53606 b=-1.40803 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	25	3	1.0000	3.395	1.473
2.0	400.	25	3	0.2500	0.849	2.026

3.0	400.	25	3	0.1111	0.377	2.195
4.0	400.	25	3	0.0625	0.212	2.259

curve #22 --> a= 0.30153 b=-1.05603 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	25	4	1.0000	2.546	1.591
2.0	400.	25	4	0.2500	0.637	2.100
3.0	400.	25	4	0.1111	0.283	2.231
4.0	400.	25	4	0.0625	0.159	2.280

curve #23 --> a= 0.19298 b=-0.84482 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	25	5	1.0000	2.037	1.693
2.0	400.	25	5	0.2500	0.509	2.146
3.0	400.	25	5	0.1111	0.226	2.254
4.0	400.	25	5	0.0625	0.127	2.293

curve #24 --> a= 0.61537 b=-1.50861 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	35	2	1.0000	3.638	1.452
2.0	400.	35	2	0.2500	0.909	2.006
3.0	400.	35	2	0.1111	0.404	2.185
4.0	400.	35	2	0.0625	0.227	2.253

curve #25 --> a= 0.27350 b=-1.00574 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	35	3	1.0000	2.425	1.613
2.0	400.	35	3	0.2500	0.606	2.111
3.0	400.	35	3	0.1111	0.269	2.237
4.0	400.	35	3	0.0625	0.152	2.283

curve #26 --> a= 0.15384 b=-0.75430 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	35	4	1.0000	1.819	1.745
2.0	400.	35	4	0.2500	0.455	2.166
3.0	400.	35	4	0.1111	0.202	2.263
4.0	400.	35	4	0.0625	0.114	2.298

curve #27 --> a= 0.09846 b=-0.60344 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	35	5	1.0000	1.455	1.840
2.0	400.	35	5	0.2500	0.364	2.200
3.0	400.	35	5	0.1111	0.162	2.279
4.0	400.	35	5	0.0625	0.091	2.308

curve #28 --> a= 0.37226 b=-1.17336 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	45	2	1.0000	2.829	1.544
2.0	400.	45	2	0.2500	0.707	2.075
3.0	400.	45	2	0.1111	0.314	2.219

4.0	400.	45	2	0.0625	0.177	2.273

curve #29 --> a= 0.16545 b=-0.78224 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	45	3	1.0000	1.886	1.728
2.0	400.	45	3	0.2500	0.472	2.160
3.0	400.	45	3	0.1111	0.210	2.260
4.0	400.	45	3	0.0625	0.118	2.297

curve #30 --> a= 0.09307 b=-0.58668 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	45	4	1.0000	1.415	1.851
2.0	400.	45	4	0.2500	0.354	2.204
3.0	400.	45	4	0.1111	0.157	2.281
4.0	400.	45	4	0.0625	0.088	2.309

curve #31 --> a= 0.05956 b=-0.46934 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	400.	45	5	1.0000	1.132	1.935
2.0	400.	45	5	0.2500	0.283	2.231
3.0	400.	45	5	0.1111	0.126	2.294
4.0	400.	45	5	0.0625	0.071	2.316

curve #32 --> a= 1.88458 b=-2.64006 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	15	4	1.0000	6.366	1.590
2.0	600.	15	4	0.2500	1.592	1.803
3.0	600.	15	4	0.1111	0.707	2.075
4.0	600.	15	4	0.0625	0.398	2.187

curve #33 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	15	5	1.0000	5.093	1.439
2.0	600.	15	5	0.2500	1.273	1.892
3.0	600.	15	5	0.1111	0.566	2.125
4.0	600.	15	5	0.0625	0.318	2.218

curve #34 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	25	3	1.0000	5.093	1.439
2.0	600.	25	3	0.2500	1.273	1.892
3.0	600.	25	3	0.1111	0.566	2.125
4.0	600.	25	3	0.0625	0.318	2.218

curve #35 --> a= 0.67845 b=-1.58404 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	25	4	1.0000	3.820	1.439
2.0	600.	25	4	0.2500	0.955	1.991
3.0	600.	25	4	0.1111	0.424	2.177
4.0	600.	25	4	0.0625	0.239	2.249

curve #36 --> a= 0.43421 b=-1.26723 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	25	5	1.0000	3.056	1.512
2.0	600.	25	5	0.2500	0.764	2.055
3.0	600.	25	5	0.1111	0.340	2.210
4.0	600.	25	5	0.0625	0.191	2.267

curve #37 --> a= 1.38459 b=-2.26291 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	35	2	1.0000	5.457	1.467
2.0	600.	35	2	0.2500	1.364	1.866
3.0	600.	35	2	0.1111	0.606	2.111
4.0	600.	35	2	0.0625	0.341	2.209

curve #38 --> a= 0.61537 b=-1.50861 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	35	3	1.0000	3.638	1.452
2.0	600.	35	3	0.2500	0.909	2.006
3.0	600.	35	3	0.1111	0.404	2.185
4.0	600.	35	3	0.0625	0.227	2.253

curve #39 --> a= 0.34615 b=-1.13146 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	35	4	1.0000	2.728	1.560
2.0	600.	35	4	0.2500	0.682	2.084
3.0	600.	35	4	0.1111	0.303	2.224
4.0	600.	35	4	0.0625	0.171	2.276

curve #40 --> a= 0.22153 b=-0.90516 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	35	5	1.0000	2.183	1.661
2.0	600.	35	5	0.2500	0.546	2.133
3.0	600.	35	5	0.1111	0.243	2.247
4.0	600.	35	5	0.0625	0.136	2.289

curve #41 --> a= 0.83759 b=-1.76004 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	45	2	1.0000	4.244	1.423
2.0	600.	45	2	0.2500	1.061	1.957
3.0	600.	45	2	0.1111	0.472	2.160
4.0	600.	45	2	0.0625	0.265	2.238

curve #42 --> a= 0.37226 b=-1.17336 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	45	3	1.0000	2.829	1.544
2.0	600.	45	3	0.2500	0.707	2.075
3.0	600.	45	3	0.1111	0.314	2.219
4.0	600.	45	3	0.0625	0.177	2.273

curve #43 --> a= 0.20940 b=-0.88002 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	45	4	1.0000	2.122	1.674
2.0	600.	45	4	0.2500	0.531	2.138
3.0	600.	45	4	0.1111	0.236	2.250
4.0	600.	45	4	0.0625	0.133	2.291

curve #44 --> a= 0.13401 b=-0.70402 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	45	5	1.0000	1.698	1.775
2.0	600.	45	5	0.2500	0.424	2.177
3.0	600.	45	5	0.1111	0.189	2.268
4.0	600.	45	5	0.0625	0.106	2.302

curve #45 --> a= 2.14423 b=-2.81607 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	15	5	1.0000	6.791	1.673
2.0	800.	15	5	0.2500	1.698	1.775
3.0	800.	15	5	0.1111	0.755	2.059
4.0	800.	15	5	0.0625	0.424	2.177

curve #46 --> a= 2.14423 b=-2.81607 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	25	3	1.0000	6.791	1.673
2.0	800.	25	3	0.2500	1.698	1.775
3.0	800.	25	3	0.1111	0.755	2.059
4.0	800.	25	3	0.0625	0.424	2.177

curve #47 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	25	4	1.0000	5.093	1.439
2.0	800.	25	4	0.2500	1.273	1.892
3.0	800.	25	4	0.1111	0.566	2.125
4.0	800.	25	4	0.0625	0.318	2.218

curve #48 --> a= 0.77192 b=-1.68964 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	25	5	1.0000	4.074	1.427
2.0	800.	25	5	0.2500	1.019	1.971
3.0	800.	25	5	0.1111	0.453	2.167
4.0	800.	25	5	0.0625	0.255	2.242

curve #49 --> a= 1.09399 b=-2.01148 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	35	3	1.0000	4.850	1.428
2.0	800.	35	3	0.2500	1.213	1.911
3.0	800.	35	3	0.1111	0.539	2.135
4.0	800.	35	3	0.0625	0.303	2.224

curve #50 --> a= 0.61537 b=-1.50861 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	35	4	1.0000	3.638	1.452
2.0	800.	35	4	0.2500	0.909	2.006
3.0	800.	35	4	0.1111	0.404	2.185
4.0	800.	35	4	0.0625	0.227	2.253

curve #51 --> a= 0.39384 b=-1.20689 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	35	5	1.0000	2.910	1.532
2.0	800.	35	5	0.2500	0.728	2.068
3.0	800.	35	5	0.1111	0.323	2.216
4.0	800.	35	5	0.0625	0.182	2.271

curve #52 --> a= 1.48905 b=-2.34672 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	45	2	1.0000	5.659	1.487
2.0	800.	45	2	0.2500	1.415	1.851
3.0	800.	45	2	0.1111	0.629	2.103
4.0	800.	45	2	0.0625	0.354	2.204

curve #53 --> a= 0.66180 b=-1.56448 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	45	3	1.0000	3.773	1.442
2.0	800.	45	3	0.2500	0.943	1.995
3.0	800.	45	3	0.1111	0.419	2.179
4.0	800.	45	3	0.0625	0.236	2.250

curve #54 --> a= 0.37226 b=-1.17336 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	45	4	1.0000	2.829	1.544
2.0	800.	45	4	0.2500	0.707	2.075
3.0	800.	45	4	0.1111	0.314	2.219
4.0	800.	45	4	0.0625	0.177	2.273

curve #55 --> a= 0.23825 b=-0.93869 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	800.	45	5	1.0000	2.264	1.645
2.0	800.	45	5	0.2500	0.566	2.125
3.0	800.	45	5	0.1111	0.252	2.244
4.0	800.	45	5	0.0625	0.141	2.287

curve #56 --> a= 1.88458 b=-2.64006 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	25	4	1.0000	6.366	1.590
2.0	1000.	25	4	0.2500	1.592	1.803
3.0	1000.	25	4	0.1111	0.707	2.075
4.0	1000.	25	4	0.0625	0.398	2.187

curve #57 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	25	5	1.0000	5.093	1.439
2.0	1000.	25	5	0.2500	1.273	1.892
3.0	1000.	25	5	0.1111	0.566	2.125
4.0	1000.	25	5	0.0625	0.318	2.218

curve #58 --> a= 1.70937 b=-2.51435 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	35	3	1.0000	6.063	1.540
2.0	1000.	35	3	0.2500	1.516	1.823
3.0	1000.	35	3	0.1111	0.674	2.087
4.0	1000.	35	3	0.0625	0.379	2.195

curve #59 --> a= 0.96152 b=-1.88576 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	35	4	1.0000	4.547	1.421
2.0	1000.	35	4	0.2500	1.137	1.934
3.0	1000.	35	4	0.1111	0.505	2.147
4.0	1000.	35	4	0.0625	0.284	2.231

curve #60 --> a= 0.61537 b=-1.50861 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	35	5	1.0000	3.638	1.452
2.0	1000.	35	5	0.2500	0.909	2.006
3.0	1000.	35	5	0.1111	0.404	2.185
4.0	1000.	35	5	0.0625	0.227	2.253

curve #61 --> a= 1.03406 b=-1.95560 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	45	3	1.0000	4.716	1.423
2.0	1000.	45	3	0.2500	1.179	1.921
3.0	1000.	45	3	0.1111	0.524	2.140
4.0	1000.	45	3	0.0625	0.295	2.227

curve #62 --> a= 0.58166 b=-1.46670 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	45	4	1.0000	3.537	1.460
2.0	1000.	45	4	0.2500	0.884	2.015
3.0	1000.	45	4	0.1111	0.393	2.189
4.0	1000.	45	4	0.0625	0.221	2.256

curve #63 --> a= 0.37226 b=-1.17336 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	45	5	1.0000	2.829	1.544
2.0	1000.	45	5	0.2500	0.707	2.075
3.0	1000.	45	5	0.1111	0.314	2.219
4.0	1000.	45	5	0.0625	0.177	2.273

curve #64 --> a= 1.73683 b=-2.53446 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF

1.0	1200.	25	5	1.0000	6.112	1.547
2.0	1200.	25	5	0.2500	1.528	1.820
3.0	1200.	25	5	0.1111	0.679	2.085
4.0	1200.	25	5	0.0625	0.382	2.193

curve #65 --> a= 1.38459 b=-2.26291 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1200.	35	4	1.0000	5.457	1.467
2.0	1200.	35	4	0.2500	1.364	1.866
3.0	1200.	35	4	0.1111	0.606	2.111
4.0	1200.	35	4	0.0625	0.341	2.209

curve #66 --> a= 0.88614 b=-1.81033 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1200.	35	5	1.0000	4.365	1.421
2.0	1200.	35	5	0.2500	1.091	1.948
3.0	1200.	35	5	0.1111	0.485	2.155
4.0	1200.	35	5	0.0625	0.273	2.235

curve #67 --> a= 1.48905 b=-2.34672 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1200.	45	3	1.0000	5.659	1.487
2.0	1200.	45	3	0.2500	1.415	1.851
3.0	1200.	45	3	0.1111	0.629	2.103
4.0	1200.	45	3	0.0625	0.354	2.204

curve #68 --> a= 0.83759 b=-1.76004 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1200.	45	4	1.0000	4.244	1.423
2.0	1200.	45	4	0.2500	1.061	1.957
3.0	1200.	45	4	0.1111	0.472	2.160
4.0	1200.	45	4	0.0625	0.265	2.238

curve #69 --> a= 0.53606 b=-1.40803 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1200.	45	5	1.0000	3.395	1.473
2.0	1200.	45	5	0.2500	0.849	2.026
3.0	1200.	45	5	0.1111	0.377	2.195
4.0	1200.	45	5	0.0625	0.212	2.259

curve #70 --> a= 1.88458 b=-2.64006 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	35	4	1.0000	6.366	1.590
2.0	1400.	35	4	0.2500	1.592	1.803
3.0	1400.	35	4	0.1111	0.707	2.075
4.0	1400.	35	4	0.0625	0.398	2.187

curve #71 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	35	5	1.0000	5.093	1.439

2.0	1400.	35	5	0.2500	1.273	1.892
3.0	1400.	35	5	0.1111	0.566	2.125
4.0	1400.	35	5	0.0625	0.318	2.218

curve #72 --> a= 2.02676 b=-2.73784 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	45	3	1.0000	6.602	1.634
2.0	1400.	45	3	0.2500	1.650	1.787
3.0	1400.	45	3	0.1111	0.734	2.066
4.0	1400.	45	3	0.0625	0.413	2.182

curve #73 --> a= 1.14005 b=-2.05338 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	45	4	1.0000	4.951	1.432
2.0	1400.	45	4	0.2500	1.238	1.903
3.0	1400.	45	4	0.1111	0.550	2.131
4.0	1400.	45	4	0.0625	0.309	2.221

curve #74 --> a= 0.72963 b=-1.64271 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	45	5	1.0000	3.961	1.432
2.0	1400.	45	5	0.2500	0.990	1.980
3.0	1400.	45	5	0.1111	0.440	2.171
4.0	1400.	45	5	0.0625	0.248	2.245

curve #75 --> a= 1.57535 b=-2.41377 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1600.	35	5	1.0000	5.821	1.507
2.0	1600.	35	5	0.2500	1.455	1.840
3.0	1600.	35	5	0.1111	0.647	2.096
4.0	1600.	35	5	0.0625	0.364	2.200

curve #76 --> a= 1.48905 b=-2.34672 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1600.	45	4	1.0000	5.659	1.487
2.0	1600.	45	4	0.2500	1.415	1.851
3.0	1600.	45	4	0.1111	0.629	2.103
4.0	1600.	45	4	0.0625	0.354	2.204

curve #77 --> a= 0.95299 b=-1.87738 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1600.	45	5	1.0000	4.527	1.421
2.0	1600.	45	5	0.2500	1.132	1.935
3.0	1600.	45	5	0.1111	0.503	2.148
4.0	1600.	45	5	0.0625	0.283	2.231

curve #78 --> a= 1.99381 b=-2.71549 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1800.	35	5	1.0000	6.548	1.623
2.0	1800.	35	5	0.2500	1.637	1.791

3.0	1800.	35	5	0.1111	0.728	2.068
4.0	1800.	35	5	0.0625	0.409	2.183

curve #79 --> a= 1.88458 b=-2.64006 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1800.	45	4	1.0000	6.366	1.590
2.0	1800.	45	4	0.2500	1.592	1.803
3.0	1800.	45	4	0.1111	0.707	2.075
4.0	1800.	45	4	0.0625	0.398	2.187

curve #80 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1800.	45	5	1.0000	5.093	1.439
2.0	1800.	45	5	0.2500	1.273	1.892
3.0	1800.	45	5	0.1111	0.566	2.125
4.0	1800.	45	5	0.0625	0.318	2.218

curve #81 --> a= 1.48905 b=-2.34672 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	2000.	45	5	1.0000	5.659	1.487
2.0	2000.	45	5	0.2500	1.415	1.851
3.0	2000.	45	5	0.1111	0.629	2.103
4.0	2000.	45	5	0.0625	0.354	2.204

curve #82 --> a= 1.80175 b=-2.58140 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	2200.	45	5	1.0000	6.225	1.565
2.0	2200.	45	5	0.2500	1.556	1.812
3.0	2200.	45	5	0.1111	0.692	2.080
4.0	2200.	45	5	0.0625	0.389	2.191

Scale-up Factor of SMALL scale RBC plants

curve # 1 --> a= 0.83759 b=-1.76004 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	15	2	1.0000	4.244	1.423
2.0	200.	15	2	0.2500	1.061	1.957
3.0	200.	15	2	0.1111	0.472	2.160
4.0	200.	15	2	0.0625	0.265	2.238

curve # 2 --> a= 0.30153 b=-1.05603 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	25	2	1.0000	2.546	1.591
2.0	200.	25	2	0.2500	0.637	2.100
3.0	200.	25	2	0.1111	0.283	2.231
4.0	200.	25	2	0.0625	0.159	2.280

curve # 3 --> a= 0.15384 b=-0.75430 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	35	2	1.0000	1.819	1.745
2.0	200.	35	2	0.2500	0.455	2.166
3.0	200.	35	2	0.1111	0.202	2.263
4.0	200.	35	2	0.0625	0.114	2.298

curve # 4 --> a= 1.38459 b=-2.26291 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	35	2	1.0000	5.457	1.467
2.0	600.	35	2	0.2500	1.364	1.866
3.0	600.	35	2	0.1111	0.606	2.111
4.0	600.	35	2	0.0625	0.341	2.209

curve # 5 --> a= 0.09307 b=-0.58668 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	45	2	1.0000	1.415	1.851
2.0	200.	45	2	0.2500	0.354	2.204
3.0	200.	45	2	0.1111	0.157	2.281
4.0	200.	45	2	0.0625	0.088	2.309

curve # 6 --> a= 0.83759 b=-1.76004 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	45	2	1.0000	4.244	1.423
2.0	600.	45	2	0.2500	1.061	1.957
3.0	600.	45	2	0.1111	0.472	2.160
4.0	600.	45	2	0.0625	0.265	2.238

curve # 7 --> a= 0.37226 b=-1.17336 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF

1.0	200.	15	3	1.0000	2.829	1.544
2.0	200.	15	3	0.2500	0.707	2.075
3.0	200.	15	3	0.1111	0.314	2.219
4.0	200.	15	3	0.0625	0.177	2.273

curve # 8 --> a= 0.13401 b=-0.70402 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	25	3	1.0000	1.698	1.775
2.0	200.	25	3	0.2500	0.424	2.177
3.0	200.	25	3	0.1111	0.189	2.268
4.0	200.	25	3	0.0625	0.106	2.302

curve # 9 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	25	3	1.0000	5.093	1.439
2.0	600.	25	3	0.2500	1.273	1.892
3.0	600.	25	3	0.1111	0.566	2.125
4.0	600.	25	3	0.0625	0.318	2.218

curve #10 --> a= 0.06837 b=-0.50287 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	35	3	1.0000	1.213	1.911
2.0	200.	35	3	0.2500	0.303	2.224
3.0	200.	35	3	0.1111	0.135	2.290
4.0	200.	35	3	0.0625	0.076	2.314

curve #11 --> a= 0.61537 b=-1.50861 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	35	3	1.0000	3.638	1.452
2.0	600.	35	3	0.2500	0.909	2.006
3.0	600.	35	3	0.1111	0.404	2.185
4.0	600.	35	3	0.0625	0.227	2.253

curve #12 --> a= 1.70937 b=-2.51435 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	35	3	1.0000	6.063	1.540
2.0	1000.	35	3	0.2500	1.516	1.823
3.0	1000.	35	3	0.1111	0.674	2.087
4.0	1000.	35	3	0.0625	0.379	2.195

curve #13 --> a= 0.04136 b=-0.39112 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	45	3	1.0000	0.943	1.995
2.0	200.	45	3	0.2500	0.236	2.250
3.0	200.	45	3	0.1111	0.105	2.302
4.0	200.	45	3	0.0625	0.059	2.321

curve #14 --> a= 0.37226 b=-1.17336 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	45	3	1.0000	2.829	1.544

2.0	600.	45	3	0.2500	0.707	2.075
3.0	600.	45	3	0.1111	0.314	2.219
4.0	600.	45	3	0.0625	0.177	2.273

curve #15 --> a= 1.03406 b=-1.95560 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	45	3	1.0000	4.716	1.423
2.0	1000.	45	3	0.2500	1.179	1.921
3.0	1000.	45	3	0.1111	0.524	2.140
4.0	1000.	45	3	0.0625	0.295	2.227

curve #16 --> a= 2.02676 b=-2.73784 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	45	3	1.0000	6.602	1.634
2.0	1400.	45	3	0.2500	1.650	1.787
3.0	1400.	45	3	0.1111	0.734	2.066
4.0	1400.	45	3	0.0625	0.413	2.182

curve #17 --> a= 0.20940 b=-0.88002 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	15	4	1.0000	2.122	1.674
2.0	200.	15	4	0.2500	0.531	2.138
3.0	200.	15	4	0.1111	0.236	2.250
4.0	200.	15	4	0.0625	0.133	2.291

curve #18 --> a= 1.88458 b=-2.64006 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	15	4	1.0000	6.366	1.590
2.0	600.	15	4	0.2500	1.592	1.803
3.0	600.	15	4	0.1111	0.707	2.075
4.0	600.	15	4	0.0625	0.398	2.187

curve #19 --> a= 0.07538 b=-0.52801 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	25	4	1.0000	1.273	1.892
2.0	200.	25	4	0.2500	0.318	2.218
3.0	200.	25	4	0.1111	0.141	2.287
4.0	200.	25	4	0.0625	0.080	2.312

curve #20 --> a= 0.67845 b=-1.58404 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	25	4	1.0000	3.820	1.439
2.0	600.	25	4	0.2500	0.955	1.991
3.0	600.	25	4	0.1111	0.424	2.177
4.0	600.	25	4	0.0625	0.239	2.249

curve #21 --> a= 1.88458 b=-2.64006 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	25	4	1.0000	6.366	1.590
2.0	1000.	25	4	0.2500	1.592	1.803

3.0	1000.	25	4	0.1111	0.707	2.075
4.0	1000.	25	4	0.0625	0.398	2.187

curve #22 --> a= 0.03846 b=-0.37715 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	35	4	1.0000	0.909	2.006
2.0	200.	35	4	0.2500	0.227	2.253
3.0	200.	35	4	0.1111	0.101	2.304
4.0	200.	35	4	0.0625	0.057	2.322

curve #23 --> a= 0.34615 b=-1.13146 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	35	4	1.0000	2.728	1.560
2.0	600.	35	4	0.2500	0.682	2.084
3.0	600.	35	4	0.1111	0.303	2.224
4.0	600.	35	4	0.0625	0.171	2.276

curve #24 --> a= 0.96152 b=-1.88576 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	35	4	1.0000	4.547	1.421
2.0	1000.	35	4	0.2500	1.137	1.934
3.0	1000.	35	4	0.1111	0.505	2.147
4.0	1000.	35	4	0.0625	0.284	2.231

curve #25 --> a= 1.88458 b=-2.64006 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	35	4	1.0000	6.366	1.590
2.0	1400.	35	4	0.2500	1.592	1.803
3.0	1400.	35	4	0.1111	0.707	2.075
4.0	1400.	35	4	0.0625	0.398	2.187

curve #26 --> a= 0.02327 b=-0.29334 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	45	4	1.0000	0.707	2.075
2.0	200.	45	4	0.2500	0.177	2.273
3.0	200.	45	4	0.1111	0.079	2.313
4.0	200.	45	4	0.0625	0.044	2.327

curve #27 --> a= 0.20940 b=-0.88002 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	45	4	1.0000	2.122	1.674
2.0	600.	45	4	0.2500	0.531	2.138
3.0	600.	45	4	0.1111	0.236	2.250
4.0	600.	45	4	0.0625	0.133	2.291

curve #28 --> a= 0.58166 b=-1.46670 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	45	4	1.0000	3.537	1.460
2.0	1000.	45	4	0.2500	0.884	2.015
3.0	1000.	45	4	0.1111	0.393	2.189

4.0	1000.	45	4	0.0625	0.221	2.256

curve #29 --> a= 1.14005 b=-2.05338 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	45	4	1.0000	4.951	1.432
2.0	1400.	45	4	0.2500	1.238	1.903
3.0	1400.	45	4	0.1111	0.550	2.131
4.0	1400.	45	4	0.0625	0.309	2.221

curve #30 --> a= 1.88458 b=-2.64006 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1800.	45	4	1.0000	6.366	1.590
2.0	1800.	45	4	0.2500	1.592	1.803
3.0	1800.	45	4	0.1111	0.707	2.075
4.0	1800.	45	4	0.0625	0.398	2.187

curve #31 --> a= 0.13401 b=-0.70402 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	15	5	1.0000	1.698	1.775
2.0	200.	15	5	0.2500	0.424	2.177
3.0	200.	15	5	0.1111	0.189	2.268
4.0	200.	15	5	0.0625	0.106	2.302

curve #32 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	15	5	1.0000	5.093	1.439
2.0	600.	15	5	0.2500	1.273	1.892
3.0	600.	15	5	0.1111	0.566	2.125
4.0	600.	15	5	0.0625	0.318	2.218

curve #33 --> a= 0.04825 b=-0.42241 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	25	5	1.0000	1.019	1.971
2.0	200.	25	5	0.2500	0.255	2.242
3.0	200.	25	5	0.1111	0.113	2.299
4.0	200.	25	5	0.0625	0.064	2.319

curve #34 --> a= 0.43421 b=-1.26723 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	25	5	1.0000	3.056	1.512
2.0	600.	25	5	0.2500	0.764	2.055
3.0	600.	25	5	0.1111	0.340	2.210
4.0	600.	25	5	0.0625	0.191	2.267

curve #35 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	25	5	1.0000	5.093	1.439
2.0	1000.	25	5	0.2500	1.273	1.892
3.0	1000.	25	5	0.1111	0.566	2.125
4.0	1000.	25	5	0.0625	0.318	2.218

curve #36 --> a= 0.02461 b=-0.30172 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	35	5	1.0000	0.728	2.068
2.0	200.	35	5	0.2500	0.182	2.271
3.0	200.	35	5	0.1111	0.081	2.312
4.0	200.	35	5	0.0625	0.045	2.326

curve #37 --> a= 0.22153 b=-0.90516 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	35	5	1.0000	2.183	1.661
2.0	600.	35	5	0.2500	0.546	2.133
3.0	600.	35	5	0.1111	0.243	2.247
4.0	600.	35	5	0.0625	0.136	2.289

curve #38 --> a= 0.61537 b=-1.50861 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	35	5	1.0000	3.638	1.452
2.0	1000.	35	5	0.2500	0.909	2.006
3.0	1000.	35	5	0.1111	0.404	2.185
4.0	1000.	35	5	0.0625	0.227	2.253

curve #39 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	35	5	1.0000	5.093	1.439
2.0	1400.	35	5	0.2500	1.273	1.892
3.0	1400.	35	5	0.1111	0.566	2.125
4.0	1400.	35	5	0.0625	0.318	2.218

curve #40 --> a= 1.99381 b=-2.71549 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1800.	35	5	1.0000	6.548	1.623
2.0	1800.	35	5	0.2500	1.637	1.791
3.0	1800.	35	5	0.1111	0.728	2.068
4.0	1800.	35	5	0.0625	0.409	2.183

curve #41 --> a= 0.01489 b=-0.23467 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	200.	45	5	1.0000	0.566	2.125
2.0	200.	45	5	0.2500	0.141	2.287
3.0	200.	45	5	0.1111	0.063	2.319
4.0	200.	45	5	0.0625	0.035	2.330

curve #42 --> a= 0.13401 b=-0.70402 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	600.	45	5	1.0000	1.698	1.775
2.0	600.	45	5	0.2500	0.424	2.177
3.0	600.	45	5	0.1111	0.189	2.268
4.0	600.	45	5	0.0625	0.106	2.302

curve #43 --> a= 0.37226 b=-1.17336 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1000.	45	5	1.0000	2.829	1.544
2.0	1000.	45	5	0.2500	0.707	2.075
3.0	1000.	45	5	0.1111	0.314	2.219
4.0	1000.	45	5	0.0625	0.177	2.273

curve #44 --> a= 0.72963 b=-1.64271 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1400.	45	5	1.0000	3.961	1.432
2.0	1400.	45	5	0.2500	0.990	1.980
3.0	1400.	45	5	0.1111	0.440	2.171
4.0	1400.	45	5	0.0625	0.248	2.245

curve #45 --> a= 1.20613 b=-2.11205 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	1800.	45	5	1.0000	5.093	1.439
2.0	1800.	45	5	0.2500	1.273	1.892
3.0	1800.	45	5	0.1111	0.566	2.125
4.0	1800.	45	5	0.0625	0.318	2.218

curve #46 --> a= 1.80175 b=-2.58140 c= 2.3450

Dia.	Q	Nd	N	1/d**2	H.L.	SUF
1.0	2200.	45	5	1.0000	6.225	1.565
2.0	2200.	45	5	0.2500	1.556	1.812
3.0	2200.	45	5	0.1111	0.692	2.080
4.0	2200.	45	5	0.0625	0.389	2.191

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