WATER RESOURCES PUBLICATION NO. 11

COMPARISON OF PERFORMANCE OF U.S. CLASS "A" EVAPORATION GALVANISED IRON PAN AND ALUMINIUM PAN

1982

JABATAN PENGAIRAN DAN SALIRAN
KEMENTERIAN PERTANIAN MALAYSIA

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Contributors:- Teh Siew Keat
Law Kong Fook

Price:— $5/-

Bahagian Parit dan Taliair
Kementerian Pertanian, Malaysia

Dicetak olih Unit Penerbitan

SUMMARY

The study attempts to establish relationships between the black painted and unpainted galvanised iron (G.I.) pans and the aluminium pan based on the available evaporation pan data observed at the D.I.D. Research Station, Ampang, Selangor.

Estimation of pan coefficients for open water, forest and grassland evaporation for unpainted galvanised iron pan and aluminium pan with reference to the pan coefficients of black painted galvanised iron US Class A pan given in Water Resources Publication No. 5 was also made.

CONTENTS

1. INTRODUCTION

1.1 In 1977, it was decided to investigate the possibility of using a metal other than galvanised iron as the standard D.I.D. US Class A Evaporation pans. The normal D.I.D. pan was made of galvanised iron which was after fabrication, coated with black paint as additional protection against corrosion. It was to eliminate this maintenance problem of regular repainting the pans that the suggestion was made to consider an alternative corrosion - resistant metal. Aluminium was chosen because it is easier to weld, lighter and cheaper than stainless steel.

2. PAN INSTALLATION

2.1 An aluminium US Class A pan was fabricated and installed alongside a standard D.I.D. black painted and an unpainted galvanised iron pans at the D.I.D. Research Station, Ampang, Selangor. The layout of these pans is shown in Plate 1.

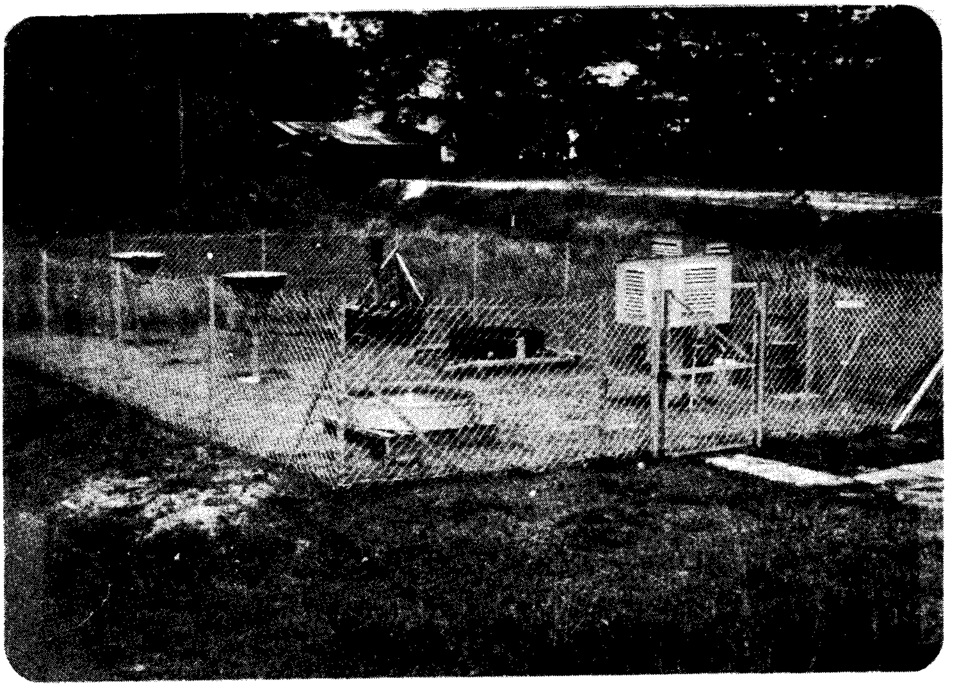

Plate 1 — Layout of Equipment

2.2 All the pans were installed according to the Hydrological Procedure No. 21 – EVAPORATION DATA COLLECTION USING U.S. CLASS A ALUMINIUM PAN' Close views of aluminium and black painted galvanised iron pans are shown in Plates 2 and 3 respectively.

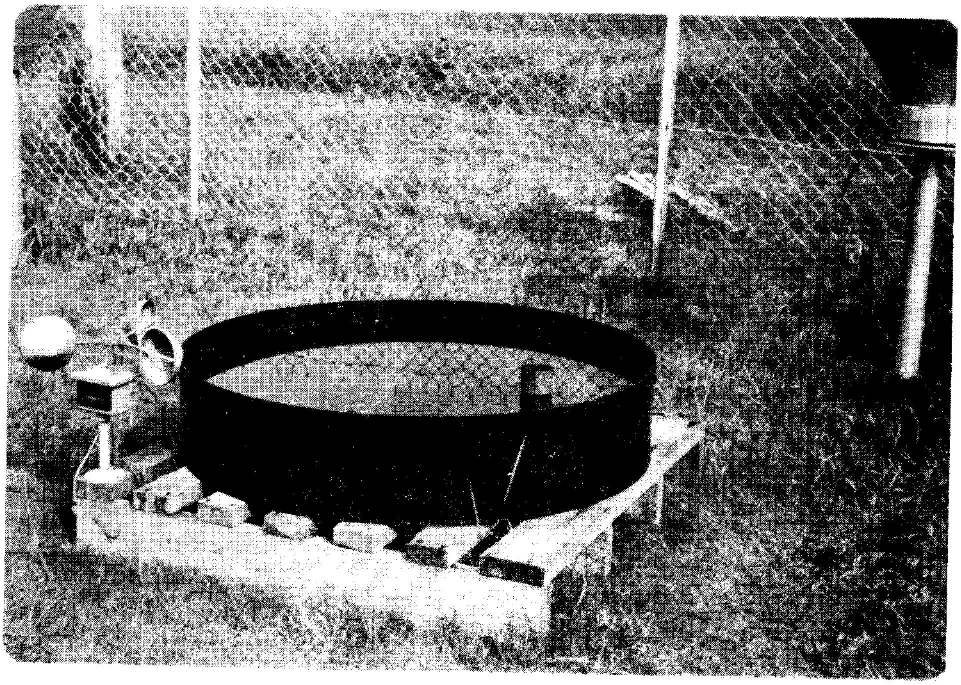

Plate 2 — Black - painted Galvanised Iron Evaporation Pan

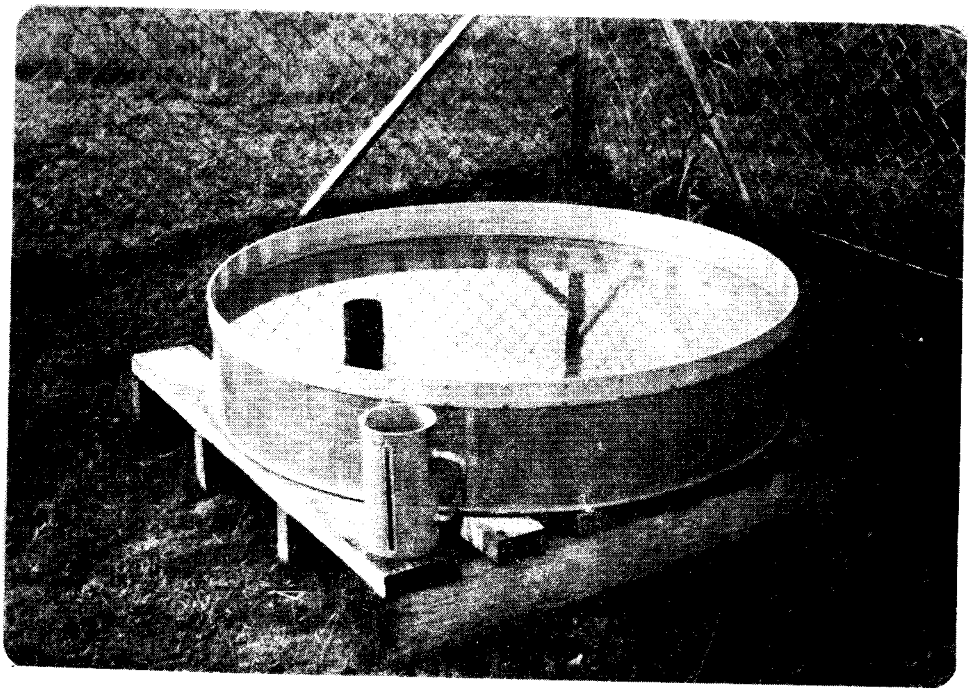

Plate 3 — Aluminium Evaporation Pan

3. OBSERVATION AND RECORDING

3.1 Twice daily manual readings (taken at 0800 and 1530 hours) commenced in July, 1977 with measurement accuracies of 0.1mm for daily rainfall and water added to or removed from the pans.

3.2 The evaporation value was calculated from records of the water level changes in the pan corrected for the amount of water added by rainfall and by artificial filling or pouring away of water. In cases when heavy and intense rains have occurred, the correction of readings might prove difficult because of loss of water by overflowing and splashing effects. Such values are usually rejected.

3.3 The records from July, 1977 to June, 1980 were analysed for this study.

4. SCREENING AND PROCESSING OF DATA

4.1 The usual D.I.D. criteria were used to screen the daily evaporation values. The observed data would be rejected if:

a) the daily rainfall exceeded 40mm.

b) the observed evaporation was less than 1mm whether rainfall occurred or not.

c) the observed evaporation was greater than 10mm if rainfall occurred.

d) the observed evaporation was greater than 15mm if rainfall did not occur.

4.2 In this study, only evaporation values without rainfall occuring in the day were chosen, simply to ensure that the data were free from splashing, overflowing and other effects.

5. ANALYSIS

5.1 Applying Linear Regression by Method of Least Squares to all three comparisons, high degree of correlation is noted in each of the resulting linear equations. As shown in Appendices I, II and III, the coefficients of correlation for the various comparisons are listed below:-

Comparison	*Correlation Coefficient*
Black painted versus Aluminium	0.8823
Unpainted versus Aluminium	0.9030
Black painted versus Unpainted	0.9029

5.2 It is felt that the following equations can be used for the respective conversion:—

Comparison I — Converting daily black painted pan readings to the equivalent aluminium pan readings and vice versa

$$Y = 0.8721X + 0.0145 \text{———————————————} \text{(IA)}$$

where X is daily black painted pan reading in mm.
and Y is equivalent aluminium pan reading in mm.

By treating the intercept of the linear equation as zero, the following equation is obtained.

$$b_I = \frac{\bar{Y}}{\bar{X}} = \frac{4.3610}{4.9839} = 0.8750$$

$$Y = 0.8750X \text{———————————————} \text{(IB)}$$

i.e. aluminium pan readings are about 12.5% less than black painted G.I. pan readings.

Comparison II — Converting daily unpainted pan readings to the equivalent aluminium pan readings and vice versa

$$Y = 0.8547X + 0.2998 \text{———————————————} \text{(IIA)}$$

where X is daily unpainted pan reading in mm.
and Y is equivalent aluminium pan reading in mm.

Similarly, by treating the intercept as zero, the following relationship is reached.

$$b_{II} = \frac{\bar{Y}}{\bar{X}} = \frac{4.1380}{4.4907} = 0.9215$$

$$Y = 0.9215X \quad \text{—————————————————(IIB)}$$

i.e. aluminium pan readings are about 7.8% less than unpainted G.I. pan readings.

Comparison III - Converting daily black painted pan readings to the equivalent unpainted pan readings and vice versa

$$Y = 0.8806X + 0.1481 \quad \text{—————————————————(IIIA)}$$

where X is daily black painted pan reading in mm.
and Y is equivalent unpainted pan reading in mm.

Again, by treating the intercept of linear equation as zero,

$$b_{III} = \frac{\bar{Y}}{\bar{X}} = \frac{4.4508}{4.8860} = 0.9109$$

$$Y = 0.9109X \quad \text{—————————————————(IIIB)}$$

i.e. unpainted G.I pan readings are about 8.9% less than black painted G.I. readings.

5.3 The above equations can be represented by the following general forms:-

$$Y = BX + A \quad \text{—————————————————(A)}$$

$$Y = bX \quad \text{—————————————————(B)}$$

Student's t-Test is then applied to test statistically if there is any significant difference between the two equations, at certain significance level α In this case, it is intended to test if the B's were significantly different from b's and A's from zero, at α of 5%.

5.4 Appendix IV shows that for Comparisions I and III, the critical t values are larger than the calculated t values whilst for Comparison II, the critical t values are less than the calculated values by a small margin, indicating that, at a confidence level of 95%, there is no significant difference between Equations (IA) and (IB) and (IIIA) and (IIIB) and that Equation (IIA) is a little bit different from Equation (IIB).

5.5 Appendix IV shows that for Comparisons I and III, the critical t values are larger than the calculated t values. Thus, at a confidence level of 95%, there is no significant difference between Equations (IA) and (IB), and (IIIA) and (IIIB). Hoever for Comparison II, the critical t value is less than the calculated t value signifying that at a confidence level of 95%, the difference betwen Equation (IIA) and Equation (IIB) is real.

5.6 Based on the above results, Equations (IA) and (IIIA) can be substituted by Equations (IB) and (IIIB) respectively for simplicity sake, whereas Equation (IIA) has to be maintained.

6. PAN COEFFICIENT

6.1 With reference to the Water Resources Publication No. 5, the pan coefficients adopted for different surfaces for the standard US Class A black painted galvanised iron pan are as shown in Table 1.

Table 1 - Pan Coefficients

Surface	Pan Coefficient
Open water	0.90
Forest	0.80
Grass	0.75

6.2 Based on the equations (B) discussed and the values in Table 1, the pan coefficients for aluminium pan and unpainted galvanised iron pan alongside with those shown in Table 1 which is for black painted galvanised iron pan are tabulated below:

Table 2 - Pan Coefficients for Black - Painted, Unpainted Galvanised Iron Pans and Aluminium Pan

Surface	Pan Coefficient		
	Black painted G.I. pan	Unpainted G.I. pan	Aluminium pan
Open water	0.90	0.99	1.03
Forest	0.80	0.88	0.91
Grass	0.75	0.82	0.86

7. DISCUSSION

7.1 The study was based on data obtained from one station only (i.e. the Ampang Research Station). Any error attributable to poor pan exposure and instrument maintenance defects like, flaking of the paint growth of the algae, accumulation of dust and other debris at the bottom of the pan which tend to change its heat transfer properties, may occur during the period of study and not easily be detected. Thus the result may not be a representative one for the whole of Peninsular Malaysia.

7.2 It is thus recommended that more evaporation pans for such comparative study should be set up at other selected locations throughout Peninsular Malaysia so that more data will be available for a representative analysis to be carried out.

8. CONCLUSION

8..1 The study shows that there exists a high degree of correlation between the data observed and the equations obtained for the various con-- versions, substantiating the objective of this study to replace the black painted or unpainted galvanised iron pans by the aluminium pans. Though the cost of constructing an aluminium pan is slightly higher than that of the gal– vanised iron pan, its low costs of maintenance justifies its usage.

LINEAR REGRESSION BY LEAST SQUARES

FOR COMPARISION I

TITLE:COMPARISON OF PERFORMANCE OF US CLASS A EVAPORATION PANS

X=DAILY READING FROM BLACK PAINTED G.T.US CLASS A PAN,JPT AMPANG JUL77-JUN80,MM

Y=DAILY READING FROM ALUMINIUM US CLASS A PAN,JPT AMPANG JUL77-JUN80,MM

ARRAY OF SIZE 485

X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
1.5	1.5	1.7	1.3	1.8	1.5	1.8	1.6	2.0	1.8	2.0	2.0	2.0	2.0	2.0	1.5	2.0	2.0	2.1	1.7	2.2	1.5	2.2	2.0	2.2	1.7
2.3	1.9	2.3	2.0	2.5	3.5	2.5	2.2	2.5	1.8	2.5	2.0	2.5	2.5	2.5	1.6	2.5	2.0	2.6	2.0	2.6	2.0	2.7	1.8	2.7	2.4
2.8	2.7	2.8	2.1	2.9	2.0	2.9	2.1	2.9	2.2	2.9	2.3	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0	2.4	3.0	2.1	3.1	2.6
3.1	2.6	3.1	3.4	3.1	2.6	3.1	2.6	3.2	2.5	3.3	3.3	3.3	2.9	3.3	5.0	3.3	3.0	3.3	2.8	3.3	2.7	3.3	2.9	3.4	2.6
3.4	2.9	3.4	3.0	3.5	2.8	3.5	2.8	3.5	3.5	3.5	3.0	3.5	3.5	3.5	3.0	3.5	3.5	3.5	3.5	3.5	4.0	3.5	3.0	3.5	3.5
3.5	3.0	3.5	2.9	3.5	2.6	3.5	3.5	3.5	3.0	3.5	3.5	3.5	3.9	3.6	2.9	3.6	2.7	3.6	2.9	3.6	2.9	3.6	3.3	3.7	3.3
3.7	3.0	3.7	3.2	3.7	3.5	3.7	3.3	3.7	3.2	3.8	3.1	3.8	3.0	3.8	2.1	3.8	2.3	3.8	3.2	3.8	3.0	3.9	3.7	3.9	3.0
3.9	3.4	3.9	3.0	3.9	3.7	3.9	2.5	3.9	3.0	3.9	2.9	3.9	3.0	3.9	3.4	4.0	4.0	4.0	4.0	4.0	3.0	4.0	3.6	4.0	3.5
4.0	4.0	4.0	3.0	4.0	3.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.5	4.0	2.9	4.0	4.0	4.0	3.5	4.0	4.0
4.0	4.0	4.0	3.2	4.0	4.0	4.0	4.0	4.0	5.8	4.0	3.2	4.0	3.6	4.0	6.1	4.0	3.1	4.0	4.0	4.0	3.5	4.0	4.0	4.0	4.0
4.0	3.2	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.5	4.1	3.4	4.1	3.4	4.1	3.2	4.1	3.7	4.1	4.3	4.2	3.5	4.2	5.4
4.2	3.7	4.2	2.1	4.2	4.0	4.2	2.9	4.3	3.4	4.3	2.8	4.3	1.0	4.3	1.9	4.3	4.0	4.3	3.0	4.3	4.0	4.3	5.7	4.3	3.7
4.3	4.0	4.3	1.5	4.4	3.9	4.4	3.5	4.4	4.1	4.5	4.5	4.5	4.0	4.5	4.5	4.5	4.5	4.5	3.8	4.5	5.0	4.5	3.5	4.5	3.8
4.5	3.7	4.5	3.9	4.5	4.5	4.5	4.5	4.5	4.5	4.5	3.5	4.5	4.5	4.5	4.5	4.5	3.5	4.5	4.0	4.5	4.0	4.5	4.0	4.5	4.0
4.5	4.5	4.5	4.5	4.5	4.4	4.5	4.0	4.5	3.8	4.5	3.7	4.5	3.2	4.5	4.5	4.5	5.5	4.6	4.3	4.6	3.9	4.6	3.7	4.6	4.0
4.6	4.3	4.6	4.2	4.6	3.7	4.6	3.9	4.6	3.7	4.6	3.7	4.7	4.5	4.7	4.0	4.7	3.6	4.7	4.2	4.7	4.0	4.7	3.9	4.7	4.3
4.7	3.8	4.7	4.3	4.7	3.9	4.7	4.1	4.8	4.3	4.8	4.0	4.8	4.2	4.8	2.2	4.8	4.2	4.8	4.3	4.8	4.2	4.8	4.3	4.8	3.8
4.8	3.8	4.8	4.2	4.8	4.5	4.9	3.7	4.9	3.9	4.9	4.0	4.9	4.4	4.9	3.7	4.9	4.3	4.9	3.7	5.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	5.0	5.5	5.0	4.3	5.0	4.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0	3.0	5.0	4.4	5.0	4.3	5.0	5.0	5.0	5.0
5.0	5.0	5.0	4.5	5.0	4.0	5.0	6.5	5.0	4.5	5.0	4.7	5.0	5.0	5.0	5.0	5.0	4.0	5.0	4.2	5.0	4.0	5.0	3.8	5.0	4.5
5.0	5.0	5.0	5.0	5.0	3.9	5.0	4.0	5.0	5.0	5.1	4.2	5.1	4.6	5.1	4.2	5.1	4.2	5.1	4.8	5.1	4.5	5.1	4.0	5.1	4.0
5.1	4.3	5.2	4.1	5.2	4.6	5.2	3.7	5.2	4.2	5.2	4.5	5.2	4.3	5.2	4.0	5.2	4.4	5.2	4.9	5.2	4.1	5.2	4.8	5.3	4.5
5.3	4.7	5.3	4.0	5.3	4.5	5.3	4.7	5.3	5.9	5.3	1.5	5.3	4.2	5.3	4.3	5.4	4.7	5.4	4.2	5.4	4.0	5.4	4.6	5.4	4.0
5.4	4.9	5.4	4.4	5.4	5.0	5.4	4.6	5.4	4.0	5.5	5.5	5.5	4.5	5.5	5.0	5.5	5.0	5.5	5.3	5.5	5.5	5.5	4.7	5.5	5.5
5.5	5.5	5.5	4.3	5.5	4.3	5.5	5.5	5.5	4.4	5.5	4.5	5.5	5.0	5.5	5.5	5.5	5.1	5.5	4.5	5.6	4.8	5.6	4.4	5.6	4.1
5.6	4.7	5.6	4.8	5.6	4.8	5.7	5.1	5.7	5.2	5.7	5.1	5.7	5.3	5.7	5.0	5.7	5.3	5.7	5.4	5.7	5.5	5.7	4.0	5.8	4.8
5.8	5.1	5.8	4.9	5.8	4.4	5.8	4.7	5.8	5.0	5.8	5.4	5.8	4.8	5.8	5.2	5.8	4.5	5.8	4.8	5.8	4.3	5.8	4.0	5.9	4.9
5.9	4.4	5.9	4.8	5.9	5.0	5.9	5.0	5.9	5.2	6.0	6.0	6.0	4.1	6.0	5.1	6.0	4.0	6.0	5.1	6.0	5.5	6.0	6.0	6.0	6.0
6.0	5.0	6.0	6.0	6.0	5.1	6.0	6.0	6.0	5.5	6.0	4.1	6.0	5.0	6.0	5.5	6.0	6.0	6.0	3.9	6.0	5.1	6.0	5.0	6.0	6.0
6.0	6.0	6.0	5.5	6.0	5.0	6.0	5.5	6.0	5.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.5	6.0	4.8	6.0	5.1	6.0	6.0	6.0	5.5
6.1	4.9	6.1	4.4	6.1	5.2	6.1	5.6	6.1	4.8	6.1	5.3	6.1	4.8	6.1	4.6	6.2	6.0	6.2	4.5	6.2	5.0	6.2	5.0	6.2	5.2
6.2	5.3	6.3	4.5	6.3	5.5	6.3	5.5	6.3	5.3	6.4	3.5	6.4	5.2	6.4	4.8	6.4	5.2	6.4	5.3	6.5	6.5	6.5	6.0	6.5	6.0
6.5	6.0	6.5	5.5	6.5	6.5	6.5	5.4	6.5	7.0	6.5	5.8	6.5	5.0	6.5	5.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
6.5	6.2	6.6	5.2	6.6	5.7	6.7	4.6	6.7	5.4	6.7	6.0	6.7	5.7	6.8	6.2	6.8	5.9	6.8	5.6	6.8	5.7	6.8	6.1	6.9	5.6
6.9	6.3	7.0	7.0	7.0	6.0	7.0	5.5	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.0	7.0	6.5	7.0	7.0	7.0	6.5	7.0	6.5	7.0	6.5
7.1	7.1	7.1	6.0	7.2	7.2	7.2	5.9	7.2	4.9	7.2	5.8	7.3	7.0	7.3	6.5	7.4	6.0	7.4	5.7	7.5	7.5	7.5	7.5	7.5	7.5
7.5	7.5	7.5	6.0	7.8	4.0	7.8	7.1	7.8	6.9	7.8	5.9	7.8	5.9	8.0	7.5	8.0	7.2	8.0	9.0	8.2	7.6	8.3	7.5	8.5	6.9
8.7	7.1	9.0	8.5	9.0	6.0	4.5	2.8																		

THE EQUATION OF REGRESSION OF Y AND X IS

Y = 0.8721X+ 0.0145

THE CORRELATION COEFFICIENT= 0.8823

LINEAR REGRESSION BY LEAST SQUARES

FOR COMPARISION II

TITLE:COMPARISON OF PERFORMANCE OF US CLASS A EVAPORATION PANS

X=DAILY READING FROM UNPAINTED GALVANIZED IRON US CLASS A PAN,JPT AMPANG MAY78-JUN80,MM

Y=DAILY READING FROM ALUMINIUM US CLASS A PAN,JPT AMPANG MAY78-JUN80,MM

ARRAY OF SIZE 332

X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
1.4	1.3	1.5	1.5	1.5	3.7	1.6	1.5	1.6	1.5	1.7	1.5	1.7	1.6	1.8	1.7	1.9	1.8	2.0	1.9	2.0	2.0	2.0	1.8	2.0	2.0
2.0	2.0	2.0	2.0	2.0	1.7	2.0	2.1	2.1	2.1	2.1	2.0	2.1	2.0	2.1	1.8	2.2	1.7	2.3	2.2	2.4	2.0	2.5	2.0	2.6	2.4
2.6	2.4	2.6	2.7	2.6	2.3	2.6	4.2	2.6	2.3	2.7	4.2	2.8	2.7	2.8	3.0	2.8	2.6	2.8	2.6	2.9	2.6	3.0	2.6	3.0	2.8
3.0	3.0	3.0	2.8	3.0	2.8	3.0	4.0	3.0	3.9	3.0	2.5	3.0	2.8	3.0	2.1	3.0	2.9	3.1	3.1	3.1	2.9	3.1	2.8	3.1	3.1
3.1	2.9	3.2	2.5	3.2	3.0	3.2	1.6	3.2	3.0	3.2	3.0	3.3	3.7	3.3	2.9	3.3	2.9	3.3	2.9	3.3	3.0	3.3	3.0	3.3	3.0
3.4	3.1	3.4	3.3	3.4	2.9	3.4	3.2	3.4	2.9	3.4	2.7	3.4	3.3	3.5	3.4	3.5	3.3	3.5	3.0	3.5	3.2	3.5	3.4	3.5	3.4
3.6	3.2	3.6	3.0	3.6	3.0	3.6	3.5	3.6	3.2	3.6	3.0	3.6	3.3	3.6	5.8	3.6	3.5	3.6	3.4	3.7	3.3	3.7	3.5	3.7	2.6
3.7	3.2	3.8	3.7	3.8	2.9	3.8	3.9	3.8	3.2	3.9	3.6	3.9	3.6	3.9	3.7	4.0	4.0	4.0	3.8	4.0	2.2	4.0	4.0	4.0	4.0
4.0	3.6	4.0	4.0	4.0	3.8	4.0	4.0	4.0	3.4	4.0	4.0	4.0	4.0	4.0	3.7	4.1	4.0	4.1	3.7	4.1	3.7	4.1	3.7	4.1	4.1
4.1	3.8	4.1	3.8	4.1	4.9	4.1	3.9	4.1	3.4	4.1	3.9	4.1	3.5	4.1	4.1	4.1	4.0	4.1	3.8	4.2	4.0	4.2	4.1	4.2	3.9
4.2	3.8	4.2	3.7	4.2	3.5	4.2	3.7	4.2	3.7	4.2	3.2	4.3	3.9	4.3	5.7	4.3	3.8	4.3	4.0	4.3	4.1	4.3	3.7	4.3	3.7
4.3	3.7	4.3	4.0	4.3	3.9	4.4	4.2	4.4	4.0	4.4	4.3	4.4	4.0	4.4	4.0	4.4	4.2	4.4	4.0	4.4	4.2	4.5	4.2	4.5	4.0
4.5	4.5	4.5	4.3	4.5	4.4	4.5	4.0	4.5	3.9	4.5	4.5	4.5	4.3	4.5	4.4	4.5	4.0	4.5	3.9	4.5	4.2	4.5	4.4	4.5	4.3
4.5	4.3	4.5	4.3	4.6	3.7	4.6	4.5	4.6	4.3	4.6	4.2	4.6	4.2	4.6	4.2	4.6	4.3	4.7	4.2	4.7	4.3	4.7	4.5	4.7	4.5
4.7	4.4	4.7	4.2	4.7	4.4	4.7	4.6	4.7	4.4	4.7	4.1	4.7	3.7	4.7	4.2	4.7	4.3	4.7	4.3	4.7	4.4	4.7	4.2	4.8	4.6
4.8	4.9	4.8	4.3	4.8	4.5	4.8	4.5	4.8	4.0	4.8	4.3	4.8	4.3	4.8	4.3	4.8	4.4	4.8	4.0	4.8	4.4	4.8	4.5	4.9	4.3
4.9	4.8	4.9	4.2	4.9	4.1	4.9	4.6	4.9	4.5	5.0	5.0	5.0	5.0	5.0	4.1	5.0	4.7	5.0	4.4	5.0	4.8	5.0	4.7	5.0	5.3
5.0	4.7	5.0	1.0	5.0	4.6	5.0	4.7	5.0	4.5	5.0	5.0	5.0	4.8	5.0	5.0	5.1	4.1	5.1	4.8	5.1	4.5	5.1	4.7	5.1	4.8
5.1	4.8	5.1	4.6	5.1	4.8	5.1	4.4	5.1	4.7	5.1	4.8	5.2	4.4	5.2	4.7	5.2	5.4	5.2	3.9	5.2	5.1	5.2	5.2	5.2	4.8
5.2	5.1	5.3	5.2	5.3	5.1	5.3	4.9	5.4	5.0	5.4	4.8	5.4	5.2	5.4	5.0	5.4	5.1	5.4	5.1	5.4	4.5	5.4	4.8	5.5	4.8
5.5	3.3	5.5	5.1	5.5	5.3	5.5	4.6	5.5	5.5	5.5	5.5	5.5	5.2	5.5	5.1	5.5	4.8	5.5	5.1	5.5	5.4	5.5	5.2	5.5	5.3
5.6	5.2	5.6	5.2	5.6	5.5	5.6	5.2	5.6	5.3	5.6	5.1	5.6	4.8	5.6	5.9	5.6	5.6	5.7	5.5	5.7	5.0	5.7	5.4	5.7	4.8
5.8	5.3	5.8	5.0	5.8	5.6	5.9	5.5	6.0	6.0	6.0	5.0	6.0	5.3	6.0	4.9	6.0	6.0	6.0	6.0	6.1	5.4	6.1	5.7	6.1	5.7
6.1	5.3	6.1	5.5	6.2	5.5	6.2	5.8	6.2	5.9	6.2	6.3	6.3	5.6	6.3	5.9	6.3	5.7	6.4	6.1	6.4	6.1	6.5	6.3	6.5	6.2
6.6	6.2	6.6	5.7	6.7	5.9	6.8	2.9	6.8	6.0	7.0	5.9	7.1	7.0	7.4	7.1	7.5	6.0	7.6	4.0	7.6	7.5	7.7	7.2	7.7	7.5
7.8	7.1	8.0	7.9	8.0	7.6	8.5	4.0	9.4	8.8	9.5	9.9	4.1	2.8												

THE EQUATION OF REGRESSION OF Y AND X IS

$$Y = 0.8547X + 0.2998$$

THE CORRELATION COEFFICIENT= 0.9030

LINEAR REGRESSION BY LEAST SQUARES

FOR COMPARISION III

TITLE:COMPARISON OF PERFORMANCE OF US CLASS A EVAPORATION PANS

X=DAILY READING FROM BLACK PAINTED G.T.US CLASS A PAN,JPT AMPANG MAY78-JUN80,MM

Y=DAILY READING FROM UNPAINTED GALVANIZED IRON US CLASS A PAN,JPT AMPANG MAY78-JUN80,MM

ARRAY OF SIZE 315

X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
1.6	1.7	1.8	1.6	1.9	1.7	2.0	1.9	2.0	1.6	2.1	2.2	2.2	1.5	2.2	2.1	2.2	2.0	2.2	2.0	2.3	2.0	2.5	2.0	2.5	2.0
2.5	2.0	2.5	3.2	2.5	2.3	2.6	2.5	2.6	2.4	2.7	2.6	2.7	2.1	2.9	2.0	2.8	2.0	2.5	2.6	2.9	2.8	2.9	2.6	3.0	2.8
3.0	2.1	3.0	2.1	3.1	3.0	3.1	2.9	3.1	2.8	3.1	2.8	3.2	3.0	3.3	3.2	3.3	3.1	3.3	2.8	3.3	3.0	3.3	3.1	3.3	3.4
3.4	3.0	3.4	6.8	3.4	3.0	3.4	3.6	3.5	3.0	3.5	3.8	3.5	3.0	3.5	3.3	3.5	3.3	3.5	3.1	3.5	3.0	3.5	5.5	3.5	3.2
3.5	3.7	3.6	3.5	3.6	3.6	3.6	3.3	3.6	3.4	3.7	3.7	3.7	3.6	3.7	3.4	3.7	3.5	3.7	3.6	3.8	2.6	3.8	3.5	3.9	3.6
3.9	3.3	3.9	3.0	3.8	3.4	3.8	3.3	3.9	3.6	3.9	4.2	3.9	3.5	3.9	3.2	3.9	4.2	3.9	3.2	3.9	3.4	3.9	2.8	4.0	3.4
4.0	3.9	4.0	3.1	4.0	3.7	4.0	3.7	4.0	4.0	4.0	3.8	4.0	3.3	4.0	3.6	4.0	6.4	4.1	4.1	4.1	3.6	4.1	3.3	4.1	3.5
4.1	3.3	4.1	4.7	4.2	3.8	4.2	3.6	4.2	3.1	4.2	4.1	4.2	3.9	4.3	3.0	4.3	4.0	4.3	4.3	4.3	4.0	4.3	3.6	4.3	4.0
4.3	4.1	4.3	4.7	4.3	4.0	4.3	5.0	4.4	4.5	4.4	4.2	4.4	4.1	4.5	4.3	4.5	4.1	4.5	4.5	4.5	4.2	4.5	3.5	4.5	4.2
4.5	1.5	4.5	4.1	4.5	4.0	4.5	4.1	4.6	4.2	4.6	4.1	4.6	4.4	4.6	4.4	4.6	4.5	4.6	4.3	4.6	4.3	4.5	4.3	4.6	4.1
4.7	3.9	4.7	4.4	4.7	4.5	4.7	4.5	4.7	4.0	4.7	3.0	4.7	4.3	4.7	4.1	4.7	4.6	4.7	4.3	4.7	4.5	4.8	4.5	4.8	4.1
4.8	4.6	4.8	4.0	4.8	4.6	4.8	4.3	4.9	2.6	4.8	4.4	4.9	4.5	4.8	4.1	4.8	4.6	4.8	4.7	4.9	4.1	4.9	4.5	4.9	4.3
4.9	4.3	4.9	4.5	5.0	4.7	5.0	4.4	5.0	4.5	5.0	4.4	5.0	4.0	5.0	4.3	5.0	4.8	5.0	4.7	5.0	4.7	5.0	5.0	5.0	4.3
5.1	4.0	5.1	4.7	5.1	4.7	5.1	5.1	5.1	4.8	5.1	2.7	5.1	4.0	5.2	4.8	5.2	4.7	5.2	4.6	5.2	4.0	5.2	4.9	5.2	5.0
5.2	5.0	5.2	4.7	5.2	5.0	5.2	5.0	5.2	4.7	5.2	4.7	5.3	4.8	5.3	5.6	5.3	4.7	5.3	5.0	5.3	4.6	5.3	4.9	5.3	5.0
5.3	5.0	5.3	4.5	5.4	5.2	5.4	4.6	5.4	4.8	5.4	4.5	5.4	5.0	5.4	4.1	5.4	4.7	5.4	4.4	5.4	5.0	5.4	4.8	5.5	4.7
5.5	4.8	5.5	5.1	5.5	5.0	5.5	4.5	5.5	5.3	5.5	5.0	5.5	4.8	5.5	4.8	5.6	5.1	5.6	5.2	5.6	4.1	5.6	5.0	5.6	5.1
5.6	5.1	5.7	5.5	5.7	4.0	5.7	5.0	5.7	5.5	5.7	5.5	5.7	5.7	5.7	5.5	5.7	5.2	5.8	5.4	5.8	4.5	5.9	5.3	5.8	5.6
5.9	5.7	5.8	5.1	5.8	4.9	5.8	5.4	5.9	4.9	5.8	5.2	5.8	5.5	5.8	4.8	5.8	5.4	5.9	5.1	5.9	5.4	5.9	5.4	5.9	4.8
6.0	4.2	6.0	5.4	6.0	5.5	6.0	5.2	6.0	5.1	6.0	5.6	6.0	5.6	6.0	5.6	6.0	5.5	6.0	5.4	6.1	5.5	6.1	5.2	6.1	5.1
6.1	5.6	6.1	4.8	6.1	5.6	6.1	5.8	6.1	5.7	6.2	6.0	6.2	5.2	6.2	5.6	6.2	4.9	6.2	6.0	6.2	5.3	6.2	5.8	6.3	5.5
6.3	5.1	6.3	6.1	6.3	5.9	6.4	6.0	6.4	5.6	6.4	5.6	6.4	5.5	6.5	5.2	6.5	6.1	6.5	6.2	6.5	5.7	6.5	6.5	6.6	6.1
6.6	5.4	6.7	6.1	6.7	6.0	6.7	6.1	6.7	6.5	6.8	6.3	6.8	6.6	6.8	6.3	6.8	6.3	6.8	6.4	6.9	5.8	7.0	6.0	7.1	6.3
7.2	6.0	7.2	6.7	7.2	6.2	7.3	7.1	7.4	6.6	7.4	7.5	7.8	7.4	7.8	6.2	7.8	7.6	7.9	7.0	8.0	7.6	8.0	7.7	8.2	8.2
8.3	7.7	8.7	7.8	4.5	4.1																				

THE EQUATION OF REGRESSION OF Y AND X IS

$$Y = 0.8806X + 0.1481$$

THE CORRELATION COEFFICIENT= 0.9029

STUDENT'S t–TEST

Comparison I = Black Painted G.I. Vs. Aluminium

Comparison II = Unpainted G.I. Vs. Aluminium

Camparison III = Black painted G.I. Vs. Unpainted G.I.

Parameter	Denotation/Formula	I	II	III
No.of data	n	485	332	315
Correlation Coeff.	r	0.8823	0.9030	0.9029
$Y^1 = BX + A$	A	0.0145	0.2998	0.1481
	B	0.8721	0.8547	0.8806
Mean of X	$\bar{X}$	4.984	4.491	4.886
Std. Deviation of residuals	$S_{Y^1} = \sqrt{\dfrac{\sum_{i=1}^{n}(Y_i - Y_i^1)^2}{n-2}}$	0.6332	0.5535	0.5575
Std. Deviation of intercept	$S_a = S_{Y^1}\sqrt{\dfrac{1}{n} + \dfrac{\bar{X}^2}{\sum_{i=1} n(x_i - \bar{x})^2}}$	0.1094	0.1050	0.1200
Std. Deviation of gradient	$S_b = \dfrac{S_{Y^1}}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2}}$	0.0212	0.0224	0.0237
	t critical	$\pm$ 1.96	$\pm$ 1.96	$\pm$ 1.96
For intercept	a	0	0	0
	t cal. $= \dfrac{A - a}{S_a}$	+ 0.13	+ 2.86	+ 1.23
For gradient	$b = \dfrac{\bar{Y}}{\bar{X}}$	0.8750	0.9215	0.9109
	t cal. $= \dfrac{B - b}{S_b}$	– 0.14	– 2.98	– 1.23

WATER RESOURCES PUBLICATIONS PREVIOUSLY PUBLISHED

1. Surface Water Resources Map (Provisional) of Peninsular Malaysia (1974) $5.00

2. Hydrological Regions of Peninsular Malaysia (1974) $6.00

3. Sungai Tekam Experimental Basin Annual Report No.1 for 1973-1974 (1975) $5.00

4. Notes on Some Hydrological Effects of Land Use Changes in Peninsular Malaysia (1975) $5.00

5. Evaporation in Peninsular Malaysia (1976). $5.00

6. Average Annual Surface Water Resources of Peninsular Malaysia - 1976 .. ..$5.00

7. Sungei Lui Representative Basin Report No.1 for 1971/72 to 1973/74 (1977) $5.00

8. Water Resources for Irrigation of Upland Crops in South Kelantan $5.00

9. Sungai Lui Representative Basin Report No.2 for 1974/75 to 1975/76 .. ..$5.00

10. Sungai Tekam Experimental Basin Report No. 2 for September, 1974 to March 1977 (1978) $5.00