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ภาคผนวก

มาตรฐานแหล่งน้ำขององค์การอนามัยโลก

WHO STANDARD OF QUALITY FOR WATER SOURCES

1. Physical Quality

The limiting value for colour should be set at 300 units, on the basis that a value of less 300 units indicates an acceptable quality for treatment and anything over 300 units indicates that special treatment may be needed to provide water meeting the drinking water standards.

With regard to turbidity, no specific figures are given since the problem of turbidity and the treatment needed is one that has to be decided for each individual case and cannot be subject to a general limit.

2. Chemical Quality

The chemical components of water are classified in four groups: (1) those compounds affecting potability; (2) those having definite effects upon health: (3) those components that are definitely toxic and whose presence in greater than the limiting amounts would be sufficient grounds for rejecting the water as a source of public supply: and (4) chemical indicators of pollution. The recommended standards for each of these groups are given below:

2.1 Compounds affecting the potability of water

Substance	Maxium allowable limit
Total dissolved solids	1,500 mg/1
Iron	50 mg/1
Manganese (assuming that the ammonis) content is less than 0.5 mg/1	5 mg/1
Copper	1.5 mg/1
Zinc	1.5 mg/1
Magnesium plus sodium suliate	1,000 mg/1
Alkyl benzyl sulfouates (ADS:surfactant)	0.5 mg/1

2.2 Components hazardous to health

Substance	maximum allowable limit
Nitrate as NO_3	45 mg/1
Fluoride	1.5 mg/1

2.3 Toxic substances

Substance	Maximum allowable limit
Phenolic substances	0.002 mg/1
Arsenic	0.05 mg/1
Cadmium	0.01 mg/1
Chromium	0.05 mg/1
Cyanide	0.2 mg/1
Lead	0.05 mg/1
Selenium	0.01 mg/1
Radionuclides (gross beta activity)	1000 uuc/1

2.4 Chemical indicators of pollution

Indicator	Minimum limit of pollution
Chemicaloxygen demand(COD)	10 mg/1
Biochemical oxygen demand (BOD)	6 mg/1
Total nitrogen exclusive of NO_3	1 mg/1
NH_3	0.5 mg/1
Carbon chloroform extract (CCE: organic pollutants)[c]	0.5 mg/1
Grease	1 mg/1

3. Bacteriological Standards

Classification	MPN/100ml Coliform bacteria
1. Bacterial quality applicable to disinfection treatment only	0-50
	MPN/100ml Coliform bacteria
II. Bacterial quality requiring conventional methods of treatment (Coagulation, filtration, disinfection)	50-5000
III. Heavy pollution, unacceptable unless special treatments designed for such water are used; source to be used only when unavoidable	greater than 50,000

มาตรฐานคุณภาพน้ำในแหล่งน้ำจืดของประเทศไทย

ดัชนีคุณภาพน้ำ	หน่วย	การแบ่งระดับคุณภาพน้ำตามการใช้ประโยชน์				
		ระดับ				
		1	2	3	4	5
อุณหภูมิ (Temperature)	องศาเซลเซียส	5	5	5	5	-
พีเอช (pH)	หน่วย	6-8	6-8	6-8	6-8	6-8
ออกซิเจนละลาย (DO)	มิลลิกรัม/ลิตร	5	6	4	2	-
บีโอดี (BOD)	มิลลิกรัม/ลิตร	-	1.5	2.0	4.0	-
โคลีฟอร์ม แบคทีเรีย	MPN/100 มิลลิกรัม					
- Total Coliform		-	5,000	20,000	-	-
- Faecal Coliform		-	1,000	4,000	-	-
ไนเตรตไนโตรเจน (NO_3)	มิลลิกรัม/ลิตร		5.0		-	-
แอมโมเนียไนโตรเจน (NH_3)	มิลลิกรัม/ลิตร		0.5		-	-
ฟีนอล (Phenols)	มิลลิกรัม/ลิตร		0.005		-	-
ทองแดง (Cu)	มิลลิกรัม/ลิตร		0.1		-	-
นิคเกิล (Ni)	มิลลิกรัม/ลิตร		0.1		-	-
แมงกานีส (Mn)	มิลลิกรัม/ลิตร		1.0		-	-
สังกะสี (Zn)	มิลลิกรัม/ลิตร		1.0		-	-
สารกัมมันตภาพรังสี	คูรี		ไม่มี		-	-
สารเป็นพิษ					-	-
ปรอททั้งหมด (Total Hg)	มิลลิกรัม/ลิตร		0.002		-	-
แคดเมียม (Cd)	มิลลิกรัม/ลิตร		0.005*		-	-
	มิลลิกรัม/ลิตร		0.05**		-	-
โครเมียม (Cr)	มิลลิกรัม/ลิตร		0.05		-	-
ตะกั่ว (Pb)	มิลลิกรัม/ลิตร		0.05		-	-
สารหนู (As)	มิลลิกรัม/ลิตร		0.01		-	-
ไซยาไนด์ (CN)	มิลลิกรัม/ลิตร		0.005		-	-
ยากำจัดศัตรูพืช	มิลลิกรัม/ลิตร		0.05		-	-

5 เป็นไปตามธรรมชาติ

5 เป็นไปตามธรรมชาติ แต่เปลี่ยนแปลงได้ไม่เกิน 3 องศาเซลเซียส

* ในน้ำที่มีความกระด้างต่ำกว่า 100 มิลลิกรัม/ลิตร ในรูป $CaCO_3$

** ในน้ำที่มีความกระด้างสูงกว่า 100 มิลลิกรัม/ลิตร ในรูป $CaCO_3$

\- ไม่พิจารณา

<u>หมายเหตุ</u> ระดับ 1 แหล่งน้ำสะอาดดีมาก ใช้ประโยชน์เพื่อ

- การอุปโภคและบริโภค โดยอาจไม่จำเป็นต้องผ่านขบวนการบำบัดน้ำ นอกจากการฆ่าเชื้อโรคอย่างปกติ (Chlorination)
- การอนุรักษ์ระบบนิเวศน์วิทยาของแหล่งน้ำ โดยใช้สิ่งมีชีวิตระดับพื้นฐานแพร่ขยายพันธุ์ตามธรรมชาติ

ระดับ 2 แหล่งน้ำสะอาดดี ใช้ประโยชน์เพื่อ

- การอุปโภคและบริโภค โดยผ่านขบวนการบำบัดโดยทั่วไปก่อนใช้
- การอนุรักษ์สัตว์น้ำทั่วไปให้มีชีวิตอยู่รอดและเอื้ออำนวยต่อการประมง
- การประมง
- การพักผ่อนหย่อนใจ

ระดับ 3 แหล่งน้ำสะอาดปานกลาง ใช้ประโยชน์เพื่อ

- การอุปโภคและบริโภค โดยต้องผ่านขบวนการบำบัดน้ำโดยทั่วไป
- การเกษตรกรรม

ระดับ 4 แหล่งน้ำสะอาดพอใช้ ใช้ประโยชน์สำหรับ

- การอุปโภคและบริโภค โดยต้องผ่านขบวนการบำบัดน้ำเป็นพิเศษ
- การอุตสาหกรรม
- กิจกรรมอื่น ๆ

ระดับ 5 แหล่งน้ำที่ไม่อยู่ในระดับ 1-4 ใช้ประโยชน์เพื่อ

- การคมนาคม

<u>ที่มา</u> : กองมาตรฐานคุณภาพสิ่งแวดล้อม สำนักงานคณะกรรมการสิ่งแวดล้อมแห่งชาติ, 2524

File : SUM

WATER QUALITY OF PING RIVER

CHARACTERISTICS	STATION 1	2	3	4	5
JULY					
Flow , cu.m./sec	74.43117	100.4384	243.6679	192.1777	257.0771
Depth , m.	1.13	1.15	3.4	2.534	2.4
Velocity , m./sec	0.8124	0.9706	1.3661	0.5186	0.62783
Air temp. ,'c	31	26.2	27	30	29
Water temp. , 'c	29.5	25.4	26	26.7	31
DO , mg/l	2.1	1.21	3.4	3.3	4.5
BOD5 , mg/l	8.05	7.5	5.1	3.3	2.2
ult.BOD , mg/l	25.2	15	11	6.02	4.42
SEPTEMBER					
Flow , cu.m./sec	105.9426	150.099	61.20838	64.19494	98.77894
Depth , m.	1.14	1.2	1.6	0.99	0.98
Velocity , m./sec	0.948	1.1627	0.557	0.510125	0.5346
Air temp. ,'c	29	28	28	29	28
Water temp. , 'c	28.5	27.5	27	28.7	30.5
DO , mg/l	6.2	5.85	6.63	6.8	6.6
BOD5 , mg/l	5.5	5.8	6.2	2.03	3.03
ult.BOD , mg/l	12.5	12	12	3	6
NOVEMBER					
Flow , cu.m./sec	256.9256	265.0733	98.82391	96.92468	400.96
Depth , m.	2.896	1.62	1.596	1.48	2.4
Velocity , m./sec	1.153534	1.1627	1.172726	1.06766	0.87674
Air temp. ,'c	28.5	32	32	30	30.5
Water temp. , 'c	25	25.2	27	27.5	30
DO , mg/l	5.86	5.62	5.56	5.86	5.2
BOD5 , mg/l	4.02	2.94	2.02	2.89	3.567
ult.BOD , mg/l	7.46	6.48	6.48	6.5	7.764
MARCH					
Flow , cu.m./sec	7.887775	15.17074	486.744	448.0517	604.3053
Depth , m.	0.95	0.854	4.733	4.58	2.7
Velocity , m./sec	0.179666	0.2548	1.337	1.344333	0.944333
Air temp. ,'c	30	33	32	35	32
Water temp. , 'c	27	26.5	24	24	25
DO , mg/l	6.5	6.54	4.11	3.8	5.78
BOD5 , mg/l	4.23	2.65	2.21	2.56	2.28
ult.BOD , mg/l	14	3.9	3.7	3.92	3.7

File LJ1

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

TALEE JULY

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	25.2	1.401400	0	0
2	5.5	19.7	1.294466	2.588932	4
4	7.5	17.7	1.247973	4.991893	16
5	8.05	17.15	1.234264	6.171320	25
8	16.5	8.7	0.939519	7.516154	64
10	21.4	3.8	0.579783	5.797835	100
15	24.05	1.15	0.060697	0.910467	225
44	83	93.4	6.758104	27.97660	434

$$\Sigma \log(L-Y) = m\Sigma x + nb$$
$$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$$

6.758104	=	44 m	+	7 b	
27.97660	=	434 m	+	44 b	
66.65948	=	434 m	+	69.04545 b	
-38.6828	=	0	+	-25.0454 b	
b	=	1.544507			
6.758104	=	44 m	+	10.81155	
m	=	-0.09212			
k	=	0.092123			
kt	=	0.142516			

File : LJ2

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

HYDRO. STATION JULY

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	15	1.176091	0	0
2	4.5	10.5	1.021189	2.042378	4
4	6	9	0.954242	3.816970	16
5	7.5	7.5	0.875061	4.375306	25
8	11.8	3.2	0.505149	4.041199	64
10	13.3	1.7	0.230448	2.304489	100
15	14.6	0.4	-0.39794	-5.96910	225
44	57.7	47.3	4.364243	10.61124	434

Σlog(L-Y) = mΣx + nb
Σxlog(L-Y) = mΣx^2 + bΣx

4.364243	=	44 m	+	7	b
10.61124	=	434 m	+	44	b
43.04730	=	434 m	+	69.04545	b
-32.4360	=	0	+	-25.0454	b
b	=	1.295087			
4.364243	=	44 m	+	9.065615	
m	=	-0.10684			
k	=	0.106849			
kt	=	0.136925			

File : LJ3

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BEHIND DAM JULY

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	11	1.041392	0	0
2	3.2	7.8	0.892094	1.784189	4
4	4.8	6.2	0.792391	3.169566	16
5	5.1	5.9	0.770852	3.854260	25
8	8.1	2.9	0.462397	3.699183	64
10	9.05	1.95	0.290034	2.900346	100
15	10.1	0.9	-0.04575	-0.68636	225
44	40.35	36.65	4.203406	14.72118	434

Σlog(L-Y) = m**Σx** + nb
Σxlog(L-Y) = mΣx^2 + bΣx

4.203406	=	44 m	+	7 b
14.72118	=	434 m	+	44 b
41.46086	=	434 m	+	69.04545 b
-26.7396	=	0	+	-25.0454 b
b	=	1.067646		
4.203406	=	44 m	+	7.473523
m	=	-0.07432		
k	=	0.074320		
kt	=	0.097901		

File : LJ4

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BANJUSSON JULY

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	6.02	0.779596	0	0
2	1.6	4.42	0.645422	1.290844	4
4	2.9	3.12	0.494154	1.976618	16
5	3.3	2.72	0.434568	2.172844	25
8	4.2	1.82	0.260071	2.080571	64
10	5.1	0.92	-0.03621	-0.36212	100
15	5.8	0.22	-0.65757	-9.86365	225
44	22.9	19.24	1.920024	-2.70490	434

Σlog(L-Y) = mΣx + nb
Σxlog(L-Y) = mΣx^2 + bΣx

1.920024	=	44 m	+	7 b
-2.70490	=	434 m	+	44 b
18.93842	=	434 m	+	69.04545 b
-21.6433	=	0	+	-25.0454 b
b	=	0.864161		
1.920024	=	44 m	+	6.049132
m	=	-0.09384		
k	=	0.093843		
kt	=	0.127657		

File : LJ5

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BANTAK JULY

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	4.42	0.645422	0	0
2	0.9	3.52	0.546542	1.093085	4
4	1.7	2.72	0.434568	1.738275	16
5	2.2	2.22	0.346352	1.731764	25
8	2.9	1.52	0.181843	1.454748	64
10	3.57	0.85	-0.07058	-0.70581	100
15	4.04	0.38	-0.42021	-6.30324	225
44	15.31	15.63	1.663932	-0.99118	434

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

1.663932	=	44 m	+	7 b
-0.99118	=	434 m	+	44 b
16.41242	=	434 m	+	69.04545 b
-17.4036	=	0	+	-25.0454 b
b	=	0.694881		
1.663932	=	44 m	+	4.864167
m	=	-0.07273		
k	=	0.072732		
kt	=	0.120543		

File : TJ1

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

TALEE JULY

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	5.5	1.875	10.3125	30.25
4	7.5	0.85	6.375	56.25
5	8.05	2.25	18.1125	64.8025
8	16.5	2.67	44.055	272.25
10	21.4	0.957142	20.48285	457.96
15	23.2	0.38	8.816	538.24
20	25.2			
n = 6	107.35	8.982142	108.1538	1419.752

na	+	bΣy	–	Σy'	=	0
aΣy	+	bΣy^2	–	Σyy	=	0
6 a	+	107.35 b	–	8.982142	=	0
107.3 a	+	1419.752 b	–	108.1538	=	0
107.3 a	+	1920.670 b	–	160.7055	=	0
0 a	+	500.9179 b	–	52.55164	=	0
		500.9179 b			=	-52.5516
				b	=	-0.10491
				k	=	0.045553
				kt	=	0.070472

File : TJ2

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

HYDRO. STATION JULY

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	4.5	1.5	6.75	20.25
4	6	1	6	36
5	7.5	1.575	11.8125	56.25
8	12.3	1.26	15.498	151.29
10	13.8	0.357142	4.928571	190.44
15	14.8	0.12	1.776	219.04
20	15			
n = 6	73.9	5.812142	46.76507	673.27

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
6 a	+	73.9 b	-	5.812142	=	0
73.9 a	+	673.27 b	-	46.76507	=	0
73.9 a	+	910.2016 b	-	71.58622	=	0
0	+	236.9316 b	-	24.82115	=	0
		236.9316 b			=	-24.8211
				b	=	-0.10476
				k	=	0.045488
				kt	=	0.058293

File : TJ3

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BEHIND DAM JULY

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	3.2	1.2	3.84	10.24
4	4.8	0.633333	3.04	23.04
5	5.1	0.825	4.2075	26.01
8	8.1	0.79	6.399	65.61
10	9.05	0.285714	2.585714	81.9025
15	10.1	0.195	1.9695	102.01
20	11			
n = 6	51.35	3.929047	22.04171	308.8125

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
6 a	+	51.35 b	-	3.929047	=	0
51.35 a	+	308.8125 b	-	22.04171	=	0
51.35 a	+	439.4704 b	-	33.62609	=	0
0	+	130.6579 b	-	11.58438	=	0
		130.6579 b			=	-11.5843
				b	=	-0.08866
				k	=	0.038498
				kt	=	0.050713

File : TJ4

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BANJUSSON JULY

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	1.6	0.725	1.16	2.56
4	2.9	0.566666	1.643333	8.41
5	3.3	0.325	1.0725	10.89
8	4.2	0.36	1.512	17.64
10	5.1	0.228571	1.165714	26.01
15	5.8	0.092	0.5336	33.64
20	6.02			
n = 6	28.92	2.297238	7.087147	99.15

na	+	bΣy	–	Σy'	=	0
aΣy	+	bΣy^2	–	Σyy	=	0
6 a	+	28.92 b	–	2.297238	=	0
28.92 a	+	99.15 b	–	7.087147	=	0
28.92 a	+	139.3944 b	–	11.07268	=	0
0	+	40.2444 b	–	3.98554	=	0
		40.2444 b			=	-3.98554
				b	=	-0.09903
				k	=	0.043001
				kt	=	0.058496

File : TJ5

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BANTAK JULY

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	0.9	0.425	0.3825	0.81
4	1.7	0.433333	0.736666	2.89
5	2.2	0.3	0.66	4.84
8	2.9	0.274	0.7946	8.41
10	3.57	0.205714	0.7344	12.7449
15	4.34	0.085	0.3689	18.8356
20	4.42			
n = 6	20.03	1.723047	3.677066	48.5305

na	+	bΣy	-	Σy'	= 0
aΣy	+	bΣy^2	-	Σyy	= 0
6 a	+	20.03 b	-	1.723047	= 0
20.03 a	+	48.5305 b	-	3.677066	= 0
20.03 a	+	66.86681 b	-	5.752107	= 0
0	+	18.33631 b	-	2.075040	= 0
		18.33631 b			= -2.07504
				b	= -0.11316
				k	= 0.049138
				kt	= 0.081439

CALCULATION DEOXYGENATION RATE BY RHAME'S TWO POINTS METHOD

TALEE JULY

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	7.5	16.5	0.25	0.833333	-0.0791812	-0.01979	29.5	-0.03062
8	16.5							
5	8.05	22.6	0.2	0.553264	-0.2570671	-0.05141		-0.07953
10	22.6	25.2	0.1	8.692307	0.93913509	0.093913		0.145285
20	25.2							

k1t = 1/(T-t)*log(x/Z-x)
= -0.03062 BOD at time 4 and 8 day
= -0.07953 BOD at time 5 and 10 day
= 0.145285 BOD at time 10 and 20 day

HYDRO. STATION JULY

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	6	11.8	0.25	1.034482	0.01472325	0.003680	25.4	0.004716
8	11.8							
5	7.5	13.3	0.2	1.293103	0.11163326	0.022326		0.028611
10	13.3	15	0.1	7.823529	0.89340271	0.089340		0.114487
20	15							

k1t = 1/(T-t)*log(x/Z-x)
= 0.004716 BOD at time 4 and 8 day
= 0.028611 BOD at time 5 and 10 day
= 0.114487 BOD at time 10 and 20 day

BEHIND DAM JULY

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	4.8	8.1	0.25	1.454545	0.16272729	0.040681	26	0.053589
8	8.1							
5	5.1	9.05	0.2	1.291139	0.11097308	0.022194		0.029236
10	9.05	11	0.1	4.641025	0.66661396	0.066661		0.087812
20	11							

k1t = 1/(T-t)*log(x/Z-x)
= 0.053589 BOD at time 4 and 8 day
= 0.029236 BOD at time 5 and 10 day
= 0.087812 BOD at time 10 and 20 day

File : RJ4

CALCULATION DEOXYGENATION RATE
BY RHAME'S TWO POINTS METHOD

BANJUSSON JULY

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	2.9	4.2	0.25	2.230769	0.34845464	0.087113	26.7	0.118502
8	4.2							
5	3.3	5.1	0.2	1.833333	0.26324143	0.052648		0.071618
10	5.1	6.02	0.1	5.543478	0.74378234	0.074378		0.101178
20	6.02							

k1t = 1/(T-t)*log(x/Z-x)
= 0.118502 BOD at time 4 and 8 day
= 0.071618 BOD at time 5 and 10 day
= 0.101178 BOD at time 10 and 20 day

BANTAK JULY

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	1.7	2.9	0.25	1.416666	0.15126767	0.037816	31	0.062675
8	2.9							
5	2.2	3.57	0.2	1.605839	0.20570211	0.041140		0.068183
10	3.57	4.42	0.1	4.2	0.62324929	0.062324		0.103294
20	4.42							

k1t = 1/(T-t)*log(x/Z-x)
= 0.062675 BOD at time 4 and 8 day
= 0.068183 BOD at time 5 and 10 day
= 0.103294 BOD at time 10 and 20 day

File : SJ2

CALCULATION DEOXYGENATION AND REAERATION RATE
BY STREETER & PHELPS METHOD

k1 = (1/*t)log(La/Lb)

k2 = k1(L'/D') - (*D/2.3tD')

JULY :BETWEEN TALEE AND HYDRO.STATION

Flow 1 , cu.m./sec	=	74.43117
Flow 2 , cu.m /sec	=	100.4384
ult.BOD 1 , mg/l	=	25.2
ult.BOD 2 , mg/l	=	15
DO 1 , mg/l	=	2.1
DO 2 , mg/l	=	1.21
Time , day	=	0.669738
DOsat.,1 , mg/l	=	7.51
DOsat.,2 , mg/l	=	8.11
La , mg/day	=	1.6E+11
Lb , mg/day	=	1.3E+11
Da , mg/day	=	3.5E+10
Db , mg/day	=	6.0E+10
k1 , /day	=	0.142091
k2 , /day	=	0.094556

JULY :BETWEEN BEHIND DAM AND BANJUSSON

Flow 3 , cu.m./sec	=	243.6779
Flow 4 , cu.m./sec	=	192.1777
ult.BOD 3 , mg/l	=	11
ult.BOD 4 , mg/l	=	6.02
DO 3 , mg/l	=	3.4
DO 4 , mg/l	=	3.3
Time , day	=	0.162738
DOsat.3 , mg/l	=	8.02
DOsat.4 , mg/l	=	7.92
La , mg/day	=	2.3E+11
Lb , mg/day	=	1.0E+11
Da , mg/day	=	9.7E+10
Db , mg/day	=	7.7E+10
k1 , /day	=	2.242311
k2 , /day	=	4.904479

File : SJ3

CALCULATION DEOXYGENATION AND REAERATION RATE
BY STREETER & PHELPS METHOD

k1 = (1/*t)log(La/Lb)

k2 = k1(L'/D') - (*D/2.3tD')

JULY :BETWEEN BANJUSSON AND BANTAK

Flow 4 , cu.m./sec	=	192.1777
Flow 5 , cu.m./sec	=	257.0771
ult.BOD 4 , mg/l	=	6.02
ult.BOD 5 , mg/l	=	4.42
DO 4 , mg/l	=	3.3
DO 5 , mg/l	=	4.5
Time , day	=	0.424234
DOsat.4 , mg/l	=	7.92
DOsat.5 , mg/l	=	7.3
La , mg/day	=	1.0E+11
Lb , mg/day	=	9.8E+10
Da , mg/day	=	7.7E+10
Db , mg/day	=	6.2E+10
k1 , /day	=	0.018418
k2 , /day	=	0.240523

CALCULATION REAERATION RATE
BY CHURCHILL EQUATION

$$k2(20'c) = 5.026*(V^{0.969}/H^{1.673})$$

$$k2(t'c) = k2(20'c)*1.0238^{(t-20)}$$

JULY

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp ('c)	k2t (/day)
TALEE	2.665353	3.707348	1.451228	29.5	1.814594
HYDRO.STATION	3.184382	3.772964	1.674417	25.4	1.901189
BEHIND DAM	4.481954	11.15485	0.380266	26	0.437903
BANJUSSON	1.701443	8.313646	0.248261	26.7	0.284783
BANTAK	1.905347	7.874013	0.297290	31	0.385077

CALCULATION REAERATION RATE
BY ISAACS' EQUATION

$$k2(20'c) = 2.833*(V/H^{3/2})$$

$$k2(t'c) = k2(20'c)*1.0238^{(t-20)}$$

JULY

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	2.665353	3.707348	1.057806	29.5	1.322665
HYDRO.STATION	3.184382	3.772964	1.230970	25.4	1.397685
BEHIND DAM	4.481954	11.15485	0.340814	26	0.392472
BANJUSSON	1.701443	8.313646	0.201083	26.7	0.235406
BANTAK	1.905347	7.874013	0.244301	31	0.316441

CALCULATION REAERATION RATE
BY OWENS EQUATION

$$k2(20'c) = 9.4*V^{0.67}*H^{-1.85}$$

$$k2(t'c) = k2(20'c)*1.0238^{(t-20)}$$

JULY

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	2.665353	3.707348	1.605522	29.5	2.007520
HYDRO.STATION	3.184382	3.772964	1.751022	25.4	1.988169
BEHIND DAM	4.481954	11.15485	0.296348	26	0.341266
BANJUSSON	1.701443	8.313646	0.266784	26.7	0.312321
BANTAK	1.905347	7.874013	0.318234	31	0.412205

File : UJ UPSTREAM JULY

****

RIVER AND WATER CHARACTERISTICS

Flow 1 , cu.m./sec	= 74.43117	*	DO 1 , mg/l	=	2.1
Flow 2 , cu.m./sec	= 100.4384	*	DO 2 , mg/l	=	1.21
Distance , Km.	= 51.587	*	ult.BOD 1 , mg/l	=	25.2
Time , day	= 0.669738	*	ult.BOD 2 , mg/l	=	15
Velocity(avg) , m./sec	= 0.8915	*	DOsat.1 , mg/l	=	7.51
Water temperature 1 , 'c	= 29.5	*	DOsat.2 , mg/l	=	8.11
Water temperature 2 , 'c	= 25.4	*	DOsat.(avg) , mg/l	=	7.81

****

k1 = 0.14 /day
k2 = 0.38 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	4.605405	3.204594
0.02	4.662175	3.147824
0.04	4.717082	3.092917
0.06	4.770163	3.039836
0.08	4.821457	2.988542
0.1	4.871000	2.938999
0.12	4.918827	2.891172
0.14	4.964974	2.845025
0.16	5.009476	2.800523
0.18	5.052366	2.757633
0.2	5.093679	2.716321
0.22	5.133445	2.676554
0.24	5.171699	2.638300
0.26	5.208470	2.601529
0.28	5.243791	2.566208
0.3	5.277692	2.532307
0.32	5.310202	2.499797
0.34	5.341351	2.468648
0.36	5.371167	2.438832
0.38	5.399679	2.410320
0.4	5.426914	2.383085
0.42	5.452900	2.357099
0.44	5.477663	2.332336
0.46	5.501229	2.308770
0.48	5.523625	2.286374
0.5	5.544875	2.265124
0.52	5.565003	2.244996
0.54	5.584036	2.225963
0.56	5.601995	2.208004
0.58	5.618904	2.191095
0.6	5.634788	2.175211
0.62	5.649667	2.160332
0.64	5.663564	2.146435
0.66	5.676501	2.133498
0.68	5.688499	2.121500

File : DJ1

DOWNSTREAM JULY

****

RIVER AND WATER CHARACTERISTICS

Flow 3 , cu.m./sec	= 243.6779	*	DO 3 , mg/l	=	3.4
Flow 4 , cu.m./sec	= 192.1777	*	DO 4 , mg/l	=	3.3
Distance , Km.	= 13.25	*	ult.BOD 3 , mg/l	=	11
Time , day	= 0.162738	*	ult.BOD 4 , mg/l	=	6.02
Velocity(avg) , m./sec	= 0.94235	*	DOsat.3 , mg/l	=	8.02
Water temperature 3 , 'c	= 26	*	DOsat.4 , mg/l	=	7.92
Water temperature 4 , 'c	= 26.7	*	DOsat.(avg) , mg/l	=	7.97

****

k1 = 0.097 /day

k2 = 0.33 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	5.165893	2.804106
0.02	5.142386	2.827613
0.04	5.118991	2.851008
0.06	5.095708	2.874291
0.08	5.072535	2.897464
0.1	5.049473	2.920526
0.12	5.026520	2.943479
0.14	5.003676	2.966323
0.16	4.980941	2.989058
0.18	4.958313	3.011686
0.2	4.935793	3.034206

File : DJ2

DOWNSTREAM JULY

****

RIVER AND WATER CHARACTERISTICS

Flow 4 , cu.m./sec	= 192.1777	*	DO 4 , mg/l	= 3.3
Flow 5 , cu.m./sec	= 257.0771	*	DO 5 , mg/l	= 4.5
Distance , Km.	= 21.01	*	ult.BOD 4 , mg/l	= 6.02
Time , day	= 0.424234	*	ult.BOD 5 , mg/l	= 4.42
Velocity(avg) , m./sec	= 0.5732	*	DOsat.4 , mg/l	= 7.92
Water temperature 4 , 'c	= 26.7	*	DOsat.5 , mg/l	= 7.3
Water temperature 5 , 'c	= 31	*	DOsat.(avg) , mg/l	= 7.61

****

k1 = 0.12 /day
k2 = 0.38 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	3.952594	3.657405
0.02	3.912163	3.697836
0.04	3.872278	3.737721
0.06	3.832931	3.777068
0.08	3.794113	3.815886
0.1	3.755816	3.854183
0.12	3.718032	3.891967
0.14	3.680752	3.929247
0.16	3.643969	3.966030
0.18	3.607675	4.002324
0.2	3.571863	4.038136
0.22	3.536524	4.073475
0.24	3.501651	4.108348
0.26	3.467237	4.142762
0.28	3.433275	4.176724
0.3	3.399758	4.210241
0.32	3.366679	4.243320
0.34	3.334032	4.275967
0.36	3.301808	4.308191
0.38	3.270002	4.339997
0.4	3.238608	4.371391
0.42	3.207619	4.402380
0.44	3.177028	4.432971

File : LS1

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

TALEE SEPTEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	12.5	1.096910	0	0
2	4.8	7.7	0.886490	1.772981	4
4	5.3	7.2	0.857332	3.429329	16
5	5.5	7	0.845098	4.225490	25
8	9.4	3.1	0.491361	3.930893	64
10	10.12	2.38	0.376576	3.765769	100
12	10.7	1.8	0.255272	3.063270	144
41	45.82	41.68	4.809042	20.18773	353

$$\Sigma \log(L-Y) = m\Sigma x + nb$$
$$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$$

4.809042	=	41	m	+	7	b
20.18773	=	353	m	+	41	b
41.40468	=	353	m	+	60.26829	b
-21.2169	=	0		+	-19.2682	b
b	=	1.101132				
4.809042	=	41	m	+	7.707929	
m	=	-0.07070				
k	=	0.070704				
kt	=	0.106897				

File : LS2

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

HYDRO. STATION SEPTEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	12	1.079181	0	0
2	4.3	7.7	0.886490	1.772981	4
4	5.5	6.5	0.812913	3.251653	16
5	5.8	6.2	0.792391	3.961958	25
8	9.4	2.6	0.414973	3.319786	64
10	9.9	2.1	0.322219	3.222192	100
12	10.3	1.7	0.230448	2.765387	144
41	45.2	38.8	4.538618	18.29396	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

4.538618	=	41 m	+	7 b
18.29396	=	353 m	+	41 b
39.07639	=	353 m	+	60.26829 b
-20.7824	=	0	+	-19.2682 b
b	=	1.078582		
4.538618	=	41 m	+	7.550075
m	=	-0.07345		
k	=	0.073450		
kt	=	0.103655		

File : LS3

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BEHIND DAM SEPTEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	12	1.079181	0	0
2	4	8	0.903089	1.806179	4
4	5.6	6.4	0.806179	3.224719	16
5	6.2	5.8	0.763427	3.817139	25
8	8.58	3.42	0.534026	4.272208	64
10	9.4	2.6	0.414973	4.149733	100
12	10.35	1.65	0.217483	2.609807	144
41	44.13	39.87	4.718362	19.87978	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

4.718362	=	41 m	+	7 b
19.87978	=	353 m	+	41 b
40.62395	=	353 m	+	60.26829 b
-20.7441	=	0	+	-19.2682 b
b	=	1.076595		
4.718362	=	41 m	+	7.536170
m	=	-0.06872		
k	=	0.068727		
kt	=	0.094788		

File : LS4

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BANJUSSON SEPTEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	3	0.477121	0	0
2	0.95	2.05	0.311753	0.623507	4
4	1.43	1.57	0.195899	0.783598	16
5	2.03	0.97	-0.01322	-0.06614	25
8	2.21	0.79	-0.10237	-0.81898	64
10	2.41	0.59	-0.22914	-2.29147	100
12	2.5	0.5	-0.30102	-3.61235	144
41	11.53	9.47	0.338995	-5.38185	353

$$\Sigma \log(L-Y) = m\Sigma x + nb$$
$$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$$

0.338995	=	41 m	+	7 b
-5.38185	=	353 m	+	41 b
2.918669	=	353 m	+	60.26829 b
-8.30052	=	0	+	-19.2682 b
b	=	0.430786		
0.338995	=	41 m	+	3.015508
m	=	-0.06528		
k	=	0.065280		
kt	=	0.097346		

File : LS5

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BANTAK SEPTEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	6	0.778151	0	0
2	1.99	4.01	0.603144	1.206288	4
4	2.68	3.32	0.521138	2.084552	16
5	3.03	2.97	0.472756	2.363782	25
8	4.12	1.88	0.274157	2.193262	64
10	5	1	0	0	100
12	5.01	0.99	-0.00436	-0.05237	144
41	21.83	20.17	2.644983	7.795508	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

2.644983	=	41 m	+	7 b
7.795508	=	353 m	+	41 b
22.77266	=	353 m	+	60.26829 b
-14.9771	=	0	+	-19.2682 b
b	=	0.777295		
2.644983	=	41 m	+	5.441066
m	=	-0.06819		
k	=	0.068197		
kt	=	0.110460		

File : TS1

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOL

TALEE SEPTEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	4.8	1.325	6.36	23.04
4	5.3	0.233333	1.236666	28.09
5	5.5	1.025	5.6375	30.25
8	9.4	0.924	8.6856	88.36
10	10.12	0.325	3.289	102.4144
12	10.7	0.296	3.1672	114.49
15	11.6	0.225	2.61	134.56
20	12.5			
n = 7	69.92	4.353333	30.98596	521.2044

na	+	bΣy	–	Σy'	=	0
aΣy	+	bΣy^2	–	Σyy	=	0
7 a	+	69.92 b	–	4.353333	=	0
69.92 a	+	521.2044 b	–	30.98596	=	0
69.92 a	+	698.4009 b	–	43.48358	=	0
0	+	177.1965 b	–	12.49761	=	0
		177.1965 b			=	-12.4976
				b	=	-0.07052
				k	=	0.030625
				kt	=	0.045250

File : TS2

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

HYDRO. STATION SEPTEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	4.3	1.375	5.9125	18.49
4	5.5	0.5	2.75	30.25
5	5.8	0.975	5.655	33.64
8	9.4	0.82	7.708	88.36
10	9.9	0.225	2.2275	98.01
12	10.3	0.22	2.266	106.09
15	11	0.2125	2.3375	121
20	12			
n = 7	68.2	4.3275	28.8565	495.84

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	68.2 b	-	4.3275	=	0
68.2 a	+	495.84 b	-	28.8565	=	0
68.2 a	+	664.4628 b	-	42.16221	=	0
0	+	168.6228 b	-	13.30571	=	0
		168.6228 b			=	-13.3057
				b	=	-0.07890
				k	=	0.034263
				kt	=	0.048353

File : TS3

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BEHIND DAM SEPTEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	4	1.4	5.6	16
4	5.6	0.733333	4.106666	31.36
5	6.2	0.745	4.619	38.44
8	8.58	0.64	5.4912	73.6164
10	9.4	0.4425	4.1595	88.36
12	10.35	0.34	3.519	107.1225
15	11.1	0.20625	2.289375	123.21
20	12			
n = 7	67.23	4.507083	29.78474	478.1089

na	+	bΣy	–	Σy'	=	0
aΣy	+	bΣy^2	–	Σyy	=	0
7 a	+	67.23 b	–	4.507083	=	0
67.23 a	+	478.1089 b	–	29.78474	=	0
67.23 a	+	645.6961 b	–	43.28731	=	0
0	+	167.5872 b	–	13.50257	=	0
		167.5872 b			=	-13.5025
				b	=	-0.08057
				k	=	0.034984
				kt	=	0.048251

File : TS4

CALCULATION DEOXYGENATION RATE BY THOMAS SLOPE METHOD

BANJUSSON SEPTEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	0.95	0.3575	0.339625	0.9025
4	1.43	0.36	0.5148	2.0449
5	2.03	0.195	0.39585	4.1209
8	2.21	0.076	0.16796	4.8841
10	2.41	0.0725	0.174725	5.8081
12	2.5	0.048	0.12	6.25
15	2.65	0.0625	0.165625	7.0225
20	3			
n = 7	17.18	1.1715	1.878585	31.033

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	17.18 b	-	1.1715	=	0
17.18 a	+	31.033 b	-	1.878585	=	0
17.18 a	+	42.16462 b	-	2.875195	=	0
0	+	11.13162 b	-	0.996610	=	0
		11.13162 b			=	-0.99661
				b	=	-0.08952
				k	=	0.038875
				kt	=	0.057970

File : TS5

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BANTAK SEPTEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	1.99	0.67	1.3333	3.9601
4	2.68	0.346666	0.929066	7.1824
5	3.03	0.36	1.0908	9.1809
8	4.12	0.394	1.62328	16.9744
10	5	0.2225	1.1125	25
12	5.01	0.1	0.501	25.1001
15	5.5	0.12375	0.680625	30.25
20	6			
n = 7	33.33	2.216916	7.270571	117.6479

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	33.33 b	-	2.216916	=	0
33.33 a	+	117.6479 b	-	7.270571	=	0
33.33 a	+	158.6984 b	-	10.55569	=	0
0	+	41.05051 b	-	3.285118	=	0
		41.05051 b			=	-3.28511
				b	=	-0.08002
				k	=	0.034748
				kt	=	0.056283

CALCULATION DEOXYGENATION RATE BY RHAME'S TWO POINTS METHOD

TALEE SEPTEMBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	5.3	9.4	0.25	1.292682	0.11149201	0.027873	28.5	0.041184
8	9.4							
5	5.5	10.1	0.2	1.190476	0.07572071	0.015144		0.022376
10	10.12	12.5	0.1	4.252100	0.62860355	0.062860		0.092880
20	12.5							

k1t = 1/(T-t)*log(x/Z-x)
= 0.041184 BOD at time 4 and 8 day
= 0.022376 BOD at time 5 and 10 day
= 0.092880 BOD at time 10 and 20 day

HYDRO.STATION SEPTEMBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	5.5	9.4	0.25	1.410256	0.14929808	0.037324	27.5	0.052673
8	9.4							
5	5.8	9.9	0.2	1.414634	0.15064413	0.030128		0.042518
10	9.9	12	0.1	4.714285	0.67341589	0.067341		0.095034
20	12							

k1t = 1/(T-t)*log(x/Z-x)
= 0.052673 BOD at time 4 and 8 day
= 0.042518 BOD at time 5 and 10 day
= 0.095034 BOD at time 10 and 20 day

BEHIND DAM SEPTEMBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	5.6	8.58	0.25	1.879194	0.27397176	0.068492	27	0.094465
8	8.58							
5	6.2	9.4	0.2	1.9375	0.28724171	0.057448		0.079232
10	9.4	12	0.1	3.615384	0.55815450	0.055815		0.076980
20	12							

k1t = 1/(T-t)*log(x/Z-x)
= 0.094465 BOD at time 4 and 8 day
= 0.079232 BOD at time 5 and 10 day
= 0.076980 BOD at time 10 and 20 day

File : RS4

CALCULATION DEOXYGENATION RATE
BY RHAME'S TWO POINTS METHOD

BANJUSSON SEPTEMBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	1.43	2.21	0.25	1.833333	0.26324143	0.065810	28.7	0.098136
8	2.21							
5	2.03	2.41	0.2	5.342105	0.72771244	0.145542		0.217033
10	2.41	3	0.1	4.084745	0.61116503	0.061116		0.091136
20	3							

k1t = 1/(T-t)*log(x/Z-x)
= 0.098136 BOD at time 4 and 8 day
= 0.217033 BOD at time 5 and 10 day
= 0.091136 BOD at time 10 and 20 day

BANTAK SEPTEMBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	2.68	4.12	0.25	1.861111	0.26977230	0.067443	30.5	0.109238
8	4.12							
5	3.03	5	0.2	1.538071	0.18697640	0.037395		0.060569
10	5	6	0.1	5	0.69897000	0.069897		0.113213
20	6							

k1t = 1/(T-t)*log(x/Z-x)
= 0.109238 BOD at time 4 and 8 day
= 0.060569 BOD at time 5 and 10 day
= 0.113213 BOD at time 10 and 20 day

File : SS1

CALCULATION DEOXYGENATION AND REAERATION RATE
BY STREETER & PHELPS METHOD

k1 = (1/*t)log(La/Lb)

k2 = k1(L'/D') - (*D/2.3tD')

SEPTEMBER : BETWEEN TALEE AND HYDRO.STATION

Flow 1 , cu.m./sec	=	105.9426
Flow 2 , cu.m./sec	=	150.099
ult.BOD 1 , mg/l	=	12.5
ult.BOD 2 , mg/l	=	12
DO 1 , mg/l	=	6.2
DO 2 , mg/l	=	5.85
Time , day	=	0.565741
DOsat.1 , mg/l	=	7.58
DOsat.2 , mg/l	=	7.22
La , mg/day	=	1.1E+11
Lb , mg/day	=	1.6E+11
Da , mg/day	=	1.3E+10
Db , mg/day	=	1.8E+10
k1 , /day	=	-0.23611
k2 , /day	=	-2.35710

SEPTEMBER : BETWEEN BEHIND DAM AND BANJUSSON

Flow 3 , cu.m./sec	=	61.2083
Flow 4 , cu.m./sec	=	64.19494
ult.BOD 3 , mg/l	=	12
ult.BOD 4 , mg/l	=	3
DO 3 , mg/l	=	6.63
DO 4 , mg/l	=	6.8
Time , day	=	0.28742
DOsat.3 , mg/l	=	7.22
DOsat.4 , mg/l	=	7.58
La , mg/day	=	6.3E+10
Lb , mg/day	=	1.7E+10
Da , mg/day	=	3.1E+09
Db , mg/day	=	4.3E+09
k1 , /day	=	2.022717
k2 , /day	=	21.26818

File : SS3

CALCULATION DEOXYGENATION AND REAERATION RATE
BY STREETER & PHELPS METHOD

k1 = (1/*t)log(La/Lb)

k2 = k1(L'/D') - (*D/2.3tD')

SEPTEMBER : BETWEEN BANJUSSON AND BANTAK

Flow 4 , cu.m./sec	=	64.19494
Flow 5 , cu.m./sec	=	98.77894
ult.BOD 4 , mg/l	=	3
ult.BOD 5 , mg/l	=	6
DO 4 , mg/l	=	6.8
DO 5 , mg/l	=	6.6
Time , day	=	0.465522
DOsat.4 , mg/l	=	7.58
DOsat.5 , mg/l	=	7.22
La , mg/day	=	1.7E+10
Lb , mg/day	=	5.1E+10
Da , mg/day	=	4.3E+09
Db , mg/day	=	5.3E+09
k1 , /day	=	-1.04870
k2 , /day	=	-7.58539

CALCULATION REAERATION RATE BY CHURCHILL EQUATION

k2(20'c) = 5.026*(V^0.969/H^1.673)

k2(t'c) = k2(20'c)*1.0238^(t-20)

SEPTEMBER

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	3.110235	3.740156	1.660713	28.5	2.028257
HYDRO. STATION	3.814631	3.937006	1.857535	27	2.189994
BEHIND DAM	1.827427	5.249342	0.562613	27	0.663309
BANJUSSON	1.673637	3.24803	1.153479	28.7	1.415407
BANTAK	1.753936	3.215222	1.227744	30.5	1.571689

CALCULATION REAERATION RATE BY ISAACS' EQUATION

k2(20'c) = 2.833*(V/H^3/2)

k2(t'c) = k2(20'c)*1.0238^(t-20)

SEPTEMBER

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	3.110235	3.740156	1.218162	28.5	1.487763
HYDRO. STATION	3.814631	3.937006	1.383407	27	1.631007
BEHIND DAM	1.827427	5.249342	0.430456	27	0.507498
BANJUSSON	1.673637	3.24803	0.809986	28.7	0.993915
BANTAK	1.753936	3.215222	0.861874	30.5	1.103323

CALCULATION REAERATION RATE BY OWENS EQUATION

k2(20'c) = 9.4*V^0.67*H^-1.85

k2(t'c) = k2(20'c)*1.0238^(t-20)

SEPTEMBER

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	3.110235	3.740156	1.751674	28.5	2.139350
HYDRO. STATION	3.814631	3.937006	1.826601	27	2.153523
BEHIND DAM	1.827427	5.249342	0.655189	27	0.772453
BANJUSSON	1.673637	3.24803	1.501356	28.7	1.842279
BANTAK	1.753936	3.215222	1.578617	30.5	2.020857

File : US

UPSTREAM SEPTEMBER

****

RIVER AND WATER CHARACTERISTICS

Flow 1 , cu.m./sec	= 105.9428	* DO 1 , mg/l	=	6.2
Flow 2 , cu.m./sec	= 150.099	* DO 2 , mg/l	=	5.85
Distance , Km.	= 51.587	* ult.BOD 1 , mg/l	=	12.5
Time , day	= 0.565741	* ult.BOD 2 , mg/l	=	12
Velocity(avg) , m./sec	= 1.05538	* DOsat.1 , mg/l	=	7.58
Water temperature 1 , 'c	= 28.5	* DOsat.2 , mg/l	=	7.22
Water temperature 2 , 'c	= 27.5	* DOsat.(avg) , mg/l	=	7.4

****

k1 = 0.104 /day
k2 = 0.42 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	1.142008	6.257991
0.02	1.169080	6.230919
0.04	1.195401	6.204598
0.06	1.220984	6.179015
0.08	1.245846	6.154153
0.1	1.270000	6.129999
0.12	1.293463	6.106536
0.14	1.316248	6.083751
0.16	1.338369	6.061630
0.18	1.359840	6.040159
0.2	1.380675	6.019324
0.22	1.400887	5.999112
0.24	1.420489	5.979510
0.26	1.439493	5.960506
0.28	1.457912	5.942087
0.3	1.475759	5.924240
0.32	1.493046	5.906953
0.34	1.509783	5.890216
0.36	1.525983	5.874016
0.38	1.541658	5.858341
0.4	1.556817	5.843182
0.42	1.571473	5.828526
0.44	1.585635	5.814364
0.46	1.599315	5.800684
0.48	1.612522	5.787477
0.5	1.625266	5.774733
0.52	1.637558	5.762441
0.54	1.649407	5.750592
0.56	1.660823	5.739176
0.58	1.671814	5.728185
0.6	1.682390	5.717609

File : DS1

DOWNSTREAM SEPTEMBER

****

RIVER AND WATER CHARACTERISTICS

Flow 3 , cu.m./sec	= 61.2083	* DO 3 , mg/l	=	6.63
Flow 4 , cu.m./sec	= 64.19494	* DO 4 , mg/l	=	6.8
Distance , Km.	= 13.25	* ult.BOD 3 , mg/l	=	12
Time , day	= 0.287420	* ult.BOD 4 , mg/l	=	3
Velocity(avg) , m./sec	= 0.533562	* DOsat.3 , mg/l	=	7.22
Water temperature 3 , 'c	= 27	* DOsat.4 , mg/l	=	7.58
Water temperature 4 , 'c	= 28.7	* DOsat.(avg) , mg/l	=	7.4

****

k1 = 0.095 /day
k2 = 0.34 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	0.575948	6.824051
0.02	0.617738	6.782261
0.04	0.658658	6.741341
0.06	0.698721	6.701278
0.08	0.737943	6.662056
0.1	0.776336	6.623663
0.12	0.813916	6.586083
0.14	0.850695	6.549304
0.16	0.886686	6.513313
0.18	0.921904	6.478095
0.2	0.956361	6.443638
0.22	0.990070	6.409929
0.24	1.023042	6.376957
0.26	1.055292	6.344707
0.28	1.086830	6.313169
0.3	1.117669	6.282330

File : DS2

DOWNSTREAM SEPTEMBER

****

RIVER AND WATER CHARACTERISTICS

Flow 4 , cu.m./sec	= 64.19494	* DO 4 , mg/l	=	6.8
Flow 5 , cu.m./sec	= 98.77894	* DO 5 , mg/l	=	6.6
Distance , Km.	= 21.01	* ult.BOD 4 , mg/l	=	3
Time , day	= 0.465522	* ult.BOD 5 , mg/l	=	6
Velocity(avg) , m./sec	= 0.522362	* DOsat.4 , mg/l	=	7.58
Water temperature 4 , 'c	= 28.7	* DOsat.5 , mg/l	=	7.22
Water temperature 5 , 'c	= 30.5	* DOsat.(avg) , mg/l	=	7.4

****

k1 = 0.097 /day
k2 = 0.36 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	0.614479	6.785520
0.02	0.614823	6.785176
0.04	0.615114	6.784885
0.06	0.615354	6.784645
0.08	0.615544	6.784455
0.1	0.615685	6.784314
0.12	0.615778	6.784221
0.14	0.615824	6.784175
0.16	0.615824	6.784175
0.18	0.615779	6.784220
0.2	0.615689	6.784310
0.22	0.615557	6.784442
0.24	0.615382	6.784617
0.26	0.615165	6.784834
0.28	0.614908	6.785091
0.3	0.614611	6.785388
0.32	0.614276	6.785723
0.34	0.613902	6.786097
0.36	0.613491	6.786508
0.38	0.613044	6.786955
0.4	0.612561	6.787438
0.42	0.612043	6.787956
0.44	0.611491	6.788508
0.46	0.610906	6.789093
0.48	0.610289	6.789710
0.5	0.609639	6.790360

File : LN1

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

TALEE NOVEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	7.46	0.872738	0	0
2	1.9	5.56	0.745074	1.490149	4
4	3.18	4.28	0.631443	2.525775	16
5	4.02	3.44	0.536558	2.682792	25
8	4.8	2.66	0.424881	3.399053	64
10	6.04	1.42	0.152288	1.522883	100
12	6.85	0.61	-0.21467	-2.57604	144
41	26.79	25.43	3.148315	9.044611	353

$\Sigma\log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

3.148315	=	41	m	+	7	b
9.044611	=	353	m	+	41	b
27.10622	=	353	m	+	60.26829	b
-18.0616	=	0		+	-19.2682	b
b	=	0.937375				
3.148315	=	41	m	+	6.561625	
m	=	-0.08325				
k	=	0.083251				
kt	=	0.104743				

File : LN2

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

HYDRO.STATION NOVEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	6.48	0.811575	0	0
2	1.23	5.25	0.720159	1.440318	4
4	2.01	4.47	0.650307	2.601230	16
5	2.94	3.54	0.549003	2.745016	25
8	3.45	3.03	0.481442	3.851541	64
10	4.23	2.25	0.352182	3.521825	100
12	4.8	1.68	0.225309	2.703711	144
41	18.66	26.7	3.789979	16.86364	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

3.789979	=	41 m	+	7 b	
16.86364	=	353 m	+	41 b	
32.63079	=	353 m	+	60.26829 b	
-15.7671	=	0	+	-19.2682 b	
b	=	0.818295			
3.789979	=	41 m	+	5.728068	
m	=	-0.04727			
k	=	0.047270			
kt	=	0.060022			

File : LN3

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BEHIND DAM NOVEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	6.48	0.811575	0	0
2	0.93	5.55	0.744292	1.488585	4
4	1.76	4.72	0.673941	2.695767	16
5	2.02	4.46	0.649334	3.246674	25
8	3	3.48	0.541579	4.332633	64
10	3.4	3.08	0.488550	4.885507	100
12	4.6	1.88	0.274157	3.289894	144
41	15.71	29.65	4.183432	19.93906	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

4.183432	=	41 m	+	7 b
19.93906	=	353 m	+	41 b
36.01833	=	353 m	+	60.26829 b
-16.0792	=	0	+	-19.2682 b
b	=	0.834493		
4.183432	=	41 m	+	5.841456
m	=	-0.04043		
k	=	0.040439		
kt	=	0.055774		

File : LN4

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BANJUSSON NOVEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	6.5	0.812913	0	0
2	0.87	5.63	0.750508	1.501016	4
4	1.97	4.53	0.656098	2.624392	16
5	2.89	3.61	0.557507	2.787536	25
8	3.45	3.05	0.484299	3.874398	64
10	4.8	1.7	0.230448	2.304489	100
12	5.1	1.4	0.146128	1.753536	144
41	19.08	26.42	3.637903	14.84536	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x \log(L-Y) = m\Sigma x^2 + b\Sigma x$

3.637903	=	41 m	+	7 b
14.84536	=	353 m	+	41 b
31.32146	=	353 m	+	60.26829 b
-16.4760	=	0	+	-19.2682 b
b	=	0.855088		
3.637903	=	41 m	+	5.985619
m	=	-0.05726		
k	=	0.057261		
kt	=	0.080809		

File : LN5

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BANTAK NOVEMBER

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	7.764	0.890085	0	0
2	1.139	6.625	0.821185	1.642371	4
4	2	5.764	0.760723	3.042895	16
5	3.567	4.197	0.622938	3.114694	25
8	4.426	3.338	0.523486	4.187890	64
10	5.565	2.199	0.342225	3.422252	100
12	5.8	1.964	0.293141	3.517697	144
41	22.497	31.851	4.253787	18.92780	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x \log(L-Y) = m\Sigma x^2 + b\Sigma x$

4.253787	=	41 m	+	7 b
18.92780	=	353 m	+	41 b
36.62407	=	353 m	+	60.26829 b
-17.6962	=	0	+	-19.2682 b
b	=	0.918413		
4.253787	=	41 m	+	6.428897
m	=	-0.05305		
k	=	0.053051		
kt	=	0.083977		

File : TN1

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

TALEE NOVEMBER

TIME	Y	Y'n	Y'y'	Y^2
0	0			
2	1.9	0.795	1.5105	3.61
4	3.18	0.706666	2.2472	10.1124
5	4.02	0.405	1.6281	16.1604
8	4.8	0.404	1.9392	23.04
10	6.04	0.5125	3.0955	36.4816
12	6.85	0.192	1.3152	46.9225
15	7	0.07625	0.53375	49
20	7.46			
n = 7	41.25	3.091416	12.26945	185.3269

na	+	bΣy	–	Σy'	=	0
aΣy	+	bΣy^2	–	Σyy	=	0
7 a	+	41.25 b	–	3.091416	=	0
41.25 a	+	185.3269 b	–	12.26945	=	0
41.25 a	+	243.0803 b	–	18.21727	=	0
0	+	57.75345 b	–	5.947826	=	0
		57.75345 b			=	-5.94782
				b	=	-0.10298
				k	=	0.044718
				kt	=	0.056262

File : TN2

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

HYDRO.STATION NOVEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	1.23	0.5025	0.618075	1.5129
4	2.01	0.57	1.1457	4.0401
5	2.94	0.36	1.0584	8.6436
8	3.45	0.258	0.8901	11.9025
10	4.23	0.3375	1.427625	17.8929
12	4.8	0.314	1.5072	23.04
15	5.8	0.21	1.218	33.64
20	6.48			
n = 7	30.94	2.552	7.8651	100.672

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	30.94 b	-	2.552	=	0
30.94 a	+	100.672 b	-	7.8651	=	0
30.94 a	+	136.7548 b	-	11.27984	=	0
0	+	36.0828 b	-	3.41474	=	0
		36.0828 b			=	-3.41474
				b	=	-0.09463
				k	=	0.041092
				kt	=	0.052177

File : TN3

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BEHIND DAM NOVEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	0.93	0.44	0.4092	0.8649
4	1.76	0.363333	0.639466	3.0976
5	2.02	0.31	0.6262	4.0804
8	3	0.276	0.828	9
10	3.4	0.4	1.36	11.56
12	4.6	0.36	1.656	21.16
15	5.2	0.235	1.222	27.04
20	6.48			
n = 7	27.39	2.384333	6.740866	76.8029

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	27.39 b	-	2.384333	=	0
27.39 a	+	76.8029 b	-	6.740866	=	0
27.39 a	+	107.1731 b	-	9.329555	=	0
0	+	30.37025 b	-	2.588689	=	0
		30.37025 b			=	-2.58868
				b	=	-0.08523
				k	=	0.037011
				kt	=	0.051046

File : TN4

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BANJUSSON NOVEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	0.87	0.4925	0.428475	0.7569
4	1.97	0.673333	1.326466	3.8809
5	2.89	0.37	1.0693	8.3521
8	3.45	0.382	1.3179	11.9025
10	4.8	0.4125	1.98	23.04
12	5.1	0.286	1.4586	26.01
15	6.23	0.175	1.09025	38.8129
20	6.5			
n = 7	31.81	2.791333	8.670991	112.7553

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	31.81 b	-	2.791333	=	0
31.81 a	+	112.7553 b	-	8.670991	=	0
31.81 a	+	144.5537 b	-	12.68461	=	0
0	+	31.79842 b	-	4.013624	=	0
		31.79842 b			=	-4.01362
				b	=	-0.12622
				k	=	0.054807
				kt	=	0.077345

File : TN5

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BANTAK NOVEMBER

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	1.139	0.5	0.5695	1.297321
4	2	0.809333	1.618666	4
5	3.567	0.6065	2.163385	12.72348
8	4.426	0.39972	1.769160	19.58947
10	5.5656	0.3435	1.911783	30.97590
12	5.8	0.43888	2.545504	33.64
15	7.76	0.2455	1.90508	60.2176
20	7.764			
n = 7	38.0216	3.343433	12.48308	162.4437

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	38.0216 b	-	3.343433	=	0
38.02 a	+	162.4437 b	-	12.48308	=	0
38.02 a	+	206.5202 b	-	18.16038	=	0
0	+	44.07650 b	-	5.677303	=	0
		44.07650 b			=	-5.67730
				b	=	-0.12880
				k	=	0.055929
				kt	=	0.088533

CALCULATION DEOXYGENATION RATE BY RHAME'S TWO POINTS METHOD

TALEE NOVENBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	3.18	4.8	0.25	1.962962	0.29291210	0.073228	25	0.092132
8	4.8							
5	4.02	6.04	0.2	1.990099	0.29887468	0.059774		0.075206
10	6.04	7.46	0.1	4.253521	0.62874859	0.062874		0.079106
20	7.46							

k1t = 1/(T-t)*log(x/Z-x)
= 0.092132 BOD at time 4 and 8 day
= 0.075206 BOD at time 5 and 10 day
= 0.079106 BOD at time 10 and 20 day

HYDRO.STATION NOVENBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	2.01	3.45	0.25	1.395833	0.14483356	0.036208	25.2	0.045976
8	3.45							
5	2.94	4.23	0.2	2.279069	0.35775762	0.071551		0.090853
10	4.23	6.48	0.1	1.88	0.27415784	0.027415		0.034811
20	6.48							

k1t = 1/(T-t)*log(x/Z-x)
= 0.045976 BOD at time 4 and 8 day
= 0.090853 BOD at time 5 and 10 day
= 0.034811 BOD at time 10 and 20 day

BEHIND DAM NOVENBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	1.76	3	0.25	1.419354	0.15209098	0.038022	27	0.052440
8	3							
5	2.02	3.4	0.2	1.463768	0.16547228	0.033094		0.045643
10	3.4	6.48	0.1	1.103896	0.04292820	0.004292		0.005920
20	6.48							

k1t = 1/(T-t)*log(x/Z-x)
= 0.052440 BOD at time 4 and 8 day
= 0.045643 BOD at time 5 and 10 day
= 0.005920 BOD at time 10 and 20 day

File : RN4

CALCULATION DEOXYGENATION RATE
BY RHAME'S TWO POINTS METHOD

BANJUSSON NOVENBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	1.97	3.45	0.25	1.331081	0.12420451	0.031051	27.5	0.043820
8	3.45							
5	2.89	4.8	0.2	1.513089	0.17986447	0.035972		0.050766
10	4.8	6.5	0.1	2.823529	0.45079231	0.045079		0.063617
20	6.5							

k1t = 1/(T-t)*log(x/Z-x)
= 0.043820 BOD at time 4 and 8 day
= 0.050766 BOD at time 5 and 10 day
= 0.063617 BOD at time 10 and 20 day

BANTAK NOVENBER

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	2	4.42	0.25	0.824402	-0.0838608	-0.02096	30	-0.03318
8	4.426							
5	3.567	5.56	0.2	1.785285	0.25170762	0.050341		0.079688
10	5.565	7.76	0.1	2.530695	0.40323993	0.040323		0.063830
20	7.764							

k1t = 1/(T-t)*log(x/Z-x)
= -0.03318 BOD at time 4 and 8 day
= 0.079688 BOD at time 5 and 10 day
= 0.063830 BOD at time 10 and 20 day

File : SN1

CALCULATION DEOXYGENATION AND REAERATION RATE
BY STREETER & PHELPS METHOD

k1 = (1/*t)log(La/Lb)

k2 = k1(L'/D') - (*D/2.3tD')

NOVEMBER : BETWEEN TALEE AND HYDRO.STATION

Flow 1 , cu.m./sec	=	256.9256
Flow 2 , cu.m./sec	=	265.0733
ult.BOD 1 , mg/l	=	7.46
ult.BOD 2 , mg/l	=	6.48
DO 1 , mg/l	=	5.86
DO 2 , mg/l	=	5.62
Time , day	=	0.517599
DOsat.1 , mg/l	=	8.18
DOsat.2 , mg/l	=	8.14
La , mg/day	=	1.7E+11
Lb , mg/day	=	1.5E+11
Da , mg/day	=	5.2E+10
Db , mg/day	=	5.8E+10
k1 , /day	=	0.091973
k2 , /day	=	0.168854

NOVEMBER : BETWEEN BEHIND DAM AND BANJUSSON

Flow 3 , cu.m./sec	=	98.82391
Flow 4 , cu.m./sec	=	96.92468
ult.BOD 3 , mg/l	=	6.48
ult.BOD 4 , mg/l	=	6.5
DO 3 , mg/l	=	5.56
DO 4 , mg/l	=	5.86
Time , day	=	0.136901
DOsat.3 , mg/l	=	7.87
DOsat.4 , mg/l	=	7.8
La , mg/day	=	5.5E+10
Lb , mg/day	=	5.4E+10
Da , mg/day	=	2.0E+10
Db , mg/day	=	1.6E+10
k1 , /day	=	0.051784
k2 , /day	=	0.772106

File : SN3

CALCULATION DEOXYGENATION AND REAERATION RATE
BY STREETER & PHELPS METHOD

k1 = (1/*t)log(La/Lb)

k2 = k1(L'/D') - (*D/2.3tD')

NOVEMBER : BETWEEN BANJUSSON AND BANTAK

Flow 4 , cu.m./sec	=	96.92468
Flow 5 , cu.m./sec	=	400.96
ult.BOD 4 , mg/l	=	6.5
ult.BOD 5 , mg/l	=	7.764
DO 4 , mg/l	=	5.86
DO 5 , mg/l	=	5.2
Time , day	=	0.250128
DOsat.4 , mg/l	=	7.8
DOsat.5 , mg/l	=	7.44
La , mg/day	=	5.4E+10
Lb , mg/day	=	2.7E+11
Da , mg/day	=	1.6E+10
Db , mg/day	=	7.8E+10
k1 , /day	=	-2.77393
k2 , /day	=	-11.8319

CALCULATION REAERATION RATE
BY CHURCHILL EQUATION

k2(20'c) = 5.026*(V^0.969/H^1.673)

k2(t'c) = k2(20'c)*1.0238^(t-20)

NOVEMBER

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	3.784559	9.501309	0.422170	25	0.474957
HYDRO. STATION	3.814631	5.314959	1.124316	25.2	1.270595
BEHIND DAM	3.847525	5.238404	1.161564	27	1.369459
BANJUSSON	3.50282	4.855641	1.204128	27.5	1.436435
BANTAK	2.876442	7.874013	0.443116	30	0.560620

CALCULATION REAERATION RATE
BY ISAACS' EQUATION

k2(20'c) = 2.833*(V/H^3/2)

k2(t'c) = k2(20'c)*1.0238^(t-20)

NOVEMBER

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	3.784559	9.501309	0.366089	25	0.411777
HYDRO. STATION	3.814631	5.314959	0.881960	25.2	0.996707
BEHIND DAM	3.847525	5.238404	0.909137	27	1.071853
BANJUSSON	3.50282	4.855641	0.927458	27.5	1.106389
BANTAK	2.876442	7.874013	0.368814	30	0.466615

CALCULATION REAERATION RATE
BY OWENS EQUATION

k2(20'c) = 9.4*V^0.67*H^-1.85

k2(t'c) = k2(20'c)*1.0238^(t-20)

NOVEMBER

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	3.784559	9.501309	0.356039	25	0.400474
HYDRO. STATION	3.814631	5.314959	1.048398	25.2	1.184799
BEHIND DAM	3.847525	5.238404	1.083131	27	1.276989
BANJUSSON	3.50282	4.855641	1.170392	27.5	1.396191
BANTAK	2.876442	7.874013	0.419370	30	0.530578

File : UN

UPSTREAM NOVEMBER

****

RIVER AND WATER CHARACTERISTICS

Flow 1 , cu.m./sec	= 256.9256	* DO 1 , mg/l	=	5.86
Flow 2 , cu.m./sec	= 265.0733	* DO 2 , mg/l	=	5.62
Distance , Km.	= 51.587	* ult.BOD 1 , mg/l	=	7.46
Time , day	= 0.517599	* ult.BOD 2 , mg/l	=	6.48
Velocity(avg) , m./sec	= 1.153539	* DOsat.1 , mg/l	=	8.18
Water temperature 1 , 'c	= 25	* DOsat.2 , mg/l	=	8.14
Water temperature 2 , 'c	= 25.2	* DOsat.(avg) , mg/l	=	8.16

****

k1 = 0.091 /day
k2 = 0.168 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	2.283787	5.876212
0.02	2.296778	5.863221
0.04	2.309541	5.850458
0.06	2.322078	5.837921
0.08	2.334392	5.825607
0.1	2.346484	5.813515
0.12	2.358358	5.801641
0.14	2.370015	5.789984
0.16	2.381457	5.778542
0.18	2.392686	5.767313
0.2	2.403706	5.756293
0.22	2.414517	5.745482
0.24	2.425122	5.734877
0.26	2.435523	5.724476
0.28	2.445723	5.714276
0.3	2.455723	5.704276
0.32	2.465525	5.694474
0.34	2.475131	5.684868
0.36	2.484544	5.675455
0.38	2.493765	5.666234
0.4	2.502796	5.657203
0.42	2.511640	5.648359
0.44	2.520297	5.639702
0.46	2.528771	5.631228
0.48	2.537063	5.622936
0.5	2.545175	5.614824
0.52	2.553109	5.606890

File : DN1

DOWNSTREAM NOVEMBER

****

RIVER AND WATER CHARACTERISTICS

Flow 3 , cu.m./sec	= 98.82391	*	DO 3 , mg/l	=	5.56
Flow 4 , cu.m./sec	= 96.92468	*	DO 4 , mg/l	=	5.86
Distance , Km.	= 13.25	*	ult.BOD 3 , mg/l	=	6.48
Time , day	= 0.136901	*	ult.BOD 4 , mg/l	=	6.5
Velocity(avg) , m./sec	= 1.120193	*	DOsat.3 , mg/l	=	7.87
Water temperature 3 , 'c	= 27	*	DOsat.4 , mg/l	=	7.8
Water temperature 4 , 'c	= 27	*	DOsat.(avg) , mg/l	=	7.835

****

k1 = 0.051 /day
k2 = 0.31 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	2.332412	5.502587
0.02	2.314591	5.520408
0.04	2.296986	5.538013
0.06	2.279596	5.555403
0.08	2.262416	5.572583
0.1	2.245444	5.589555
0.12	2.228678	5.606321
0.14	2.212114	5.622885

File : DN2

DOWNSTREAM NOVEMBER

****

RIVER AND WATER CHARACTERISTICS

Flow 4 , cu.m./sec	= 96.92468	*	DO 4 , mg/l	= 5.86
Flow 5 , cu.m./sec	= 400.96	*	DO 5 , mg/l	= 5.2
Distance , Km.	= 21.01	*	ult.BOD 4 , mg/l	= 6.5
Time , day	= 0.250124	*	ult.BOD 5 , mg/l	= 7.764
Velocity(avg) , m./sec	= 0.9722	*	DOsat.4 , mg/l	= 7.8
Water temperature 4 , 'c	= 27	*	DOsat.5 , mg/l	= 7.44
Water temperature 5 , 'c	= 30	*	DOsat.(avg) , mg/l	= 7.62

****

k1 = 0.088 /day
k2 = 0.21 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	0.755331	6.864668
0.02	0.758247	6.861752
0.04	0.761094	6.858905
0.06	0.763873	6.856126
0.08	0.766584	6.853415
0.1	0.769228	6.850771
0.12	0.771806	6.848193
0.14	0.774319	6.845680
0.16	0.776768	6.843231
0.18	0.779153	6.840846
0.2	0.781476	6.838523
0.22	0.783736	6.836263
0.24	0.785935	6.834064
0.26	0.788073	6.831926

File : LM1

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

TALEE MARCH

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	14	1.146128	0	0
2	2.26	11.74	1.069668	2.139336	4
4	3.38	10.62	1.026124	4.104498	16
5	4.23	9.77	0.989894	4.949472	25
8	6.79	7.21	0.857935	6.863482	64
10	8.72	5.28	0.722633	7.226339	100
12	12.39	1.61	0.206825	2.481910	144
41	37.77	60.23	6.019210	27.76503	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

6.019210	=	41 m	+	7 b
27.76503	=	353 m	+	41 b
51.82393	=	353 m	+	60.26829 b
-24.0588	=	0	+	-19.2682 b
b	=	1.248626		
6.019210	=	41 m	+	8.740382
m	=	-0.06637		
k	=	0.066370		
kt	=	0.091537		

File : LM2

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

HYDRO. STATION MARCH

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	3.9	0.591064	0	0
2	1.52	2.38	0.376576	0.753153	4
4	2.45	1.45	0.161368	0.645472	16
5	2.65	1.25	0.096910	0.484550	25
8	3.02	0.88	-0.05551	-0.44413	64
10	3.19	0.71	-0.14874	-1.48741	100
12	3.39	0.51	-0.29242	-3.50915	144
41	16.22	11.08	0.729230	-3.55753	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x \log(L-Y) = m\Sigma x^2 + b\Sigma x$

0.729230	=	41 m	+	7 b
-3.55753	=	353 m	+	41 b
6.278499	=	353 m	+	60.26829 b
-9.83603	=	0	+	-19.2682 b
b	=	0.510477		
0.729230	=	41 m	+	3.573344
m	=	-0.06936		
k	=	0.069368		
kt	=	0.093501		

File : LM3

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BEHIND DAM MARCH

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	3.7	0.568201	0	0
2	1.21	2.49	0.396199	0.792398	4
4	1.99	1.71	0.232996	0.931984	16
5	2.21	1.49	0.173186	0.865931	25
8	3.01	0.69	-0.16115	-1.28920	64
10	3.1	0.6	-0.22184	-2.21848	100
12	3.26	0.44	-0.35654	-4.27856	144
41	14.78	11.12	0.631036	-5.19594	353

Σlog(L-Y) = mΣx + nb
Σxlog(L-Y) = mΣx^2 + bΣx

0.631036	=	41 m	+	7 b
-5.19594	=	353 m	+	41 b
5.433070	=	353 m	+	60.26829 b
-10.6290	=	0	+	-19.2682 b
b	=	0.551632		
0.631036	=	41 m	+	3.861428
m	=	-0.07879		
k	=	0.078790		
kt	=	0.094679		

File : LM4

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BANJUSSON MARCH

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	3.92	0.593286	0	0
2	1.26	2.66	0.424881	0.849763	4
4	2.21	1.71	0.232996	0.931984	16
5	2.56	1.36	0.133538	0.667694	25
8	3.17	0.75	-0.12493	-0.99950	64
10	3.21	0.71	-0.14874	-1.48741	100
12	3.34	0.58	-0.23657	-2.83886	144
41	15.75	11.69	0.874450	-2.87634	353

$\Sigma\log(L-Y) = m\Sigma x + nb$
$\Sigma x\log(L-Y) = m\Sigma x^2 + b\Sigma x$

0.874450	=	41 m	+	7	b
-2.87634	=	353 m	+	41	b
7.528804	=	353 m	+	60.26829	b
-10.4051	=	0	+	-19.2682	b
b	=	0.540014			
0.874450	=	41 m	+	3.780099	
m	=	-0.07086			
k	=	0.070869			
kt	=	0.085162			

File : LM5

CALCULATION DEOXYGENATION RATE
BY LEAST SQUARE METHOD

BANTAK MARCH

X	Y	L-Y	Log(L-Y)	xlog(L-Y)	x^2
0	0	3.7	0.568201	0	0
2	1.01	2.69	0.429752	0.859504	4
4	1.98	1.72	0.235528	0.942113	16
5	2.28	1.42	0.152288	0.761441	25
8	3	0.7	-0.15490	-1.23921	64
10	3.09	0.61	-0.21467	-2.14670	100
12	3.1	0.6	-0.22184	-2.66218	144
41	14.46	11.44	0.794349	-3.48504	353

$\Sigma \log(L-Y) = m\Sigma x + nb$
$\Sigma x \log(L-Y) = m\Sigma x^2 + b\Sigma x$

0.794349	=	41 m	+	7 b
-3.48504	=	353 m	+	41 b
6.839159	=	353 m	+	60.26829 b
-10.3242	=	0	+	-19.2682 b
b	=	0.535812		
0.794349	=	41 m	+	3.750690
m	=	-0.07210		
k	=	0.072105		
kt	=	0.090720		

File : TM1

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

TALEE MARCH

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	2.26	0.845	1.9097	5.1076
4	3.38	0.656666	2.219533	11.4244
5	4.23	0.8525	3.606075	17.8929
8	6.79	0.898	6.09742	46.1041
10	8.72	1.4	12.208	76.0384
12	12.39	0.956	11.84484	153.5121
15	13.5	0.20125	2.716875	182.25
20	14			
n = 7	65.27	5.809416	40.60244	492.3295

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	65.27 b	-	5.809416	=	0
65.27 a	+	492.3295 b	-	40.60244	=	0
65.27 a	+	608.5961 b	-	54.16866	=	0
0	+	116.2666 b	-	13.56621	=	0
		116.2666 b			=	-13.5662
				b	=	-0.11668
				k	=	0.050665
				kt	=	0.069877

File : TM2

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

HYDRO. STATION MARCH

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	1.52	0.6125	0.931	2.3104
4	2.45	0.376666	0.922833	6.0025
5	2.65	0.1425	0.377625	7.0225
8	3.02	0.108	0.32616	9.1204
10	3.19	0.0925	0.295075	10.1761
12	3.39	0.106	0.35934	11.4921
15	3.72	0.06375	0.23715	13.8384
20	3.9			
n = 7	23.84	1.501916	3.449183	59.9624

na	+	bΣy	−	Σy'	=	0
aΣy	+	bΣy^2	−	Σyy	=	0
7 a	+	23.84 b	−	1.501916	=	0
23.84 a	+	59.9624 b	−	3.449183	=	0
23.84 a	+	81.19222 b	−	5.115099	=	0
0	+	21.22982 b	−	1.665915	=	0
		21.22982 b			=	-1.66591
				b	=	-0.07847
				k	=	0.034073
				kt	=	0.045926

File : TM3

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BEHIND DAM MARCH

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	1.21	0.4975	0.601975	1.4641
4	1.99	0.333333	0.663333	3.9601
5	2.21	0.255	0.56355	4.8841
8	3.01	0.178	0.53578	9.0601
10	3.1	0.0625	0.19375	9.61
12	3.26	0.076	0.24776	10.6276
15	3.48	0.055	0.1914	12.1104
20	3.7			
n = 7	21.96	1.457333	2.997548	51.7164

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	21.96 b	-	1.457333	=	0
21.96 a	+	51.7164 b	-	2.997548	=	0
21.96 a	+	68.89165 b	-	4.571862	=	0
0	+	17.17525 b	-	1.574314	=	0
		17.17525 b			=	-1.57431
				b	=	-0.09166
				k	=	0.039801
				kt	=	0.047827

File : TM4

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BANJUSSON MARCH

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	1.26	0.5525	0.69615	1.5876
4	2.21	0.433333	0.957666	4.8841
5	2.56	0.24	0.6144	6.5536
8	3.17	0.13	0.4121	10.0489
10	3.21	0.0425	0.136425	10.3041
12	3.34	0.09	0.3006	11.1556
15	3.66	0.0725	0.26535	13.3956
20	3.92			
n = 7	23.33	1.560833	3.382691	57.9295

na	+	bΣy	–	Σy'	=	0
aΣy	+	bΣy^2	–	Σyy	=	0
7 a	+	23.33 b	–	1.560833	=	0
23.33 a	+	57.9295 b	–	3.382691	=	0
23.33 a	+	77.75555 b	–	5.202034	=	0
0	+	19.82605 b	–	1.819342	=	0
		19.82605 b			=	-1.81934
				b	=	-0.09176
				k	=	0.039845
				kt	=	0.047881

File : TM5

CALCULATION DEOXYGENATION RATE
BY THOMAS SLOPE METHOD

BANTAK MARCH

TIME	Y	Y'n	Y'y	Y^2
0	0			
2	1.01	0.495	0.49995	1.0201
4	1.98	0.423333	0.8382	3.9204
5	2.28	0.255	0.5814	5.1984
8	3	0.162	0.486	9
10	3.09	0.025	0.07725	9.5481
12	3.1	0.098	0.3038	9.61
15	3.58	0.075	0.2685	12.8164
20	3.7			
n = 7	21.74	1.533333	3.0551	51.1134

na	+	bΣy	-	Σy'	=	0
aΣy	+	bΣy^2	-	Σyy	=	0
7 a	+	21.74 b	-	1.533333	=	0
21.74 a	+	51.1134 b	-	3.0551	=	0
21.74 a	+	67.51822 b	-	4.762095	=	0
0	+	16.40482 b	-	1.706995	=	0
		16.40482 b			=	-1.70699
				b	=	-0.10405
				k	=	0.045182
				kt	=	0.056846

CALCULATION DEOXYGENATION RATE BY RHAME'S TWO POINTS METHOD

TALEE MARCH

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	3.38	6.79	0.25	0.991202	-0.0038376	-0.00095	27	-0.00132
8	6.79							
5	4.23	8.72	0.2	0.942093	-0.0259059	-0.00518		-0.00714
10	8.72	14	0.1	1.651515	0.21788256	0.021788		0.030050
20	14							

k1t = 1/(T-t)*log(x/Z-x)
= -0.00132 BOD at time 4 and 8 day
= -0.00714 BOD at time 5 and 10 day
= 0.030050 BOD at time 10 and 20 day

HYDRO. STATION MARCH

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	2.45	3.02	0.25	4.298245	0.63329122	0.158322	26.5	0.213401
8	3.02							
5	2.65	3.19	0.2	4.907407	0.69085211	0.138170		0.186238
10	3.19	3.9	0.1	4.492957	0.65253233	0.065253		0.087953
20	3.9							

k1t = 1/(T-t)*log(x/Z-x)
= 0.213401 BOD at time 4 and 8 day
= 0.186238 BOD at time 5 and 10 day
= 0.087953 BOD at time 10 and 20 day

BEHIND DAM MARCH

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	1.99	3.01	0.25	1.950980	0.29025290	0.072563	24	0.087197
8	3.01							
5	2.21	3.1	0.2	2.483146	0.39500226	0.079000		0.094932
10	3.1	3.7	0.1	5.166666	0.71321044	0.071321		0.085704
20	3.7							

k1t = 1/(T-t)*log(x/Z-x)
= 0.087197 BOD at time 4 and 8 day
= 0.094932 BOD at time 5 and 10 day
= 0.085704 BOD at time 10 and 20 day

File : RM4

CALCULATION DEOXYGENATION RATE
BY RHAME'S TWO POINTS METHOD

BANJUSSON MARCH

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	2.21	3.17	0.25	2.302083	0.36212104	0.090530	24	0.108787
8	3.17							
5	2.56	3.21	0.2	3.938461	0.59532660	0.119065		0.143077
10	3.21	3.92	0.1	4.521126	0.65524668	0.065524		0.078739
20	3.92							

k1t = 1/(T-t)*log(x/Z-x)
= 0.108787 BOD at time 4 and 8 day
= 0.143077 BOD at time 5 and 10 day
= 0.078739 BOD at time 10 and 20 day

BANTAK MARCH

Time	x	Z	1/(T-t)	x/(Z-x)	log x/(Z-x)	k1	temp	k1t
4	1.98	3	0.25	1.941176	0.28806501	0.072016	25	0.090607
8	3							
5	2.28	3.09	0.2	2.814814	0.44944982	0.089889		0.113095
10	3.09	3.7	0.1	5.065573	0.70462864	0.070462		0.088653
20	3.7							

k1t = 1/(T-t)*log(x/Z-x)
= 0.090607 BOD at time 4 and 8 day
= 0.113095 BOD at time 5 and 10 day
= 0.088653 BOD at time 10 and 20 day

File : SM1

CALCULATION DEOXYGENATION AND REAERATION RATE
BY STREETER & PHELPS METHOD

k1 = (1/*t)log(La/Lb)

k2 = k1(L'/D') - (*D/2.3*tD')

MARCH : BETWEEN TALEE AND HYDRO.STATION

Flow 1 , cu.m./sec	=	7.887775
Flow 2 , cu.m./sec	=	15.17074
ult.BOD 1 , mg/l	=	14
ult.BOD 2 , mg/l	=	3.9
DO 1 , mg/l	=	6.5
DO 2 , mg/l	=	6.54
Time , day	=	2.748531
DOsat.1 , mg/l	=	7.87
DOsat.2 , mg/l	=	7.95
La , mg/day	=	9.5E+09
Lb , mg/day	=	5.1E+09
Da , mg/day	=	9.3E+08
Db , mg/day	=	1.8E+09
k1 , /day	=	0.098602
k2 , /day	=	0.415372

MARCH : BETWEEN BEHIND DAM AND BANJUSSON

Flow 3 , cu.m./sec	=	486.744
Flow 4 , cu.m./sec	=	448.0517
ult.BOD 3 , mg/l	=	3.7
ult.BOD 4 , mg/l	=	3.92
DO 3 , mg/l	=	4.11
DO 4 , mg/l	=	3.8
Time , day	=	0.114388
DOsat.3 , mg/l	=	8.33
DOsat.4 , mg/l	=	8.33
La , mg/day	=	1.6E+11
Lb , mg/day	=	1.5E+11
Da , mg/day	=	1.8E+11
Db , mg/day	=	1.8E+11
k1 , /day	=	0.095185
k2 , /day	=	0.128309

File : SM3

CALCULATION DEOXYGENATION AND REAERATION RATE
BY STREETER & PHELPS METHOD

k1 = (1/*t)log(La/Lb)

k2 = k1(L'/D') - (*D/2.3tD')

MARCH , : BETWEEN PANJUSSON AND BANTAK

Flow 4 , cu.m./sec	=	448.0517
Flow 5 , cu.m./sec	=	604.3053
ult.BOD 4 , mg/l	=	3.92
ult.BOD 5 , mg/l	=	3.7
DO 4 , mg/l	=	3.8
DO 5 , mg/l	=	5.78
Time , day	=	0.2125
DOsat.4 , mg/l	=	8.33
DOsat.5 , mg/l	=	8.18
La , mg/day	=	1.5E+11
Lb , mg/day	=	1.9E+11
Da , mg/day	=	1.8E+11
Db , mg/day	=	1.3E+11
k1 , /day	=	-0.49338
k2 , /day	=	0.115223

BY CHURCHILL EQUATION

k2(20'c) = 5.026*(V^0.969/H^1.673)

k2(t'c) = k2(20'c)*1.0238^(t-20)

MARCH

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	0.589455	3.116797	0.449588	27	0.530054
HYDRO.STATION	0.835957	2.801836	0.753784	26.5	0.876305
BEHIND DAM	4.386481	15.52929	0.214109	24	0.235232
BANJUSSON	4.41054	15.02624	0.227438	24	0.249876
BANTAK	3.098204	8.858265	0.391015	25	0.438814

CALCULATION REAERATION RATE
BY ISAACS' EQUATION

k2(20'c) = 2.883*(V/H^3/2)

k2(t'c) = k2(20'c)*1.0238^(t-20)

MARCH

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	0.589455	3.116797	0.303483	27	0.357799
HYDRO.STATION	0.835957	2.801836	0.504971	26.5	0.588389
BEHIND DAM	4.386481	15.52929	0.203065	24	0.223098
BANJUSSON	4.41054	15.02624	0.214517	24	0.235680
BANTAK	3.098204	8.858265	0.332915	25	0.374463

CALCULATION REAERATION RATE
BY OWENS EQUATION

k2(20'c) = 9.4*V^0.67*H^-1.85

k2(t'c) = k2(20'c)*1.0238^(t-20)

MARCH

STATION	Velocity (ft/sec)	Depth (ft)	k2 (/day)	Temp. ('c)	k2t (/day)
TALEE	0.589455	3.116797	0.805321	27	0.949456
HYDRO.STATION	0.835957	2.801836	1.239430	26.5	1.444176
BEHIND DAM	4.386481	15.52929	0.158385	24	0.174010
BANJUSSON	4.41054	15.02624	0.168952	24	0.185619
BANTAK	3.098204	8.858265	0.354467	25	0.398705

File : UM

UPSTREAM MARCH

****

RIVER AND WATER CHARACTERISTICS

Flow 1 , cu.m./sec	= 7.887775	* DO 1 , mg/l	= 6.5
Flow 2 , cu.m./sec	= 15.17074	* DO 2 , mg/l	= 6.54
Distance , Km.	= 51.587	* ult.BOD 1 , mg/l	= 14
Time , day	= 2.748531	* ult.BOD 2 , mg/l	= 3.9
Velocity(avg) , m./sec	= 0.217233	* DOsat.1 , mg/l	= 7.87
Water temperature 1 , 'c	= 27	* DOsat.2 , mg/l	= 7.95
Water temperature 2 , 'c	= 26.5	* DOsat.(avg) , mg/l	= 7.91

****

k1 = 0.098 /day

k2 = 0.41 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	0.937289	6.972710
0.1	1.056751	6.853248
0.2	1.160902	6.749097
0.3	1.251222	6.658777
0.4	1.329057	6.580942
0.5	1.395628	6.514371
0.6	1.452045	6.457954
0.7	1.499315	6.410684
0.8	1.538354	6.371645
0.9	1.569991	6.340008
1	1.594980	6.315019
1.1	1.614004	6.295995
1.2	1.627684	6.282315
1.3	1.636582	6.273417
1.4	1.641208	6.268791
1.5	1.642025	6.267974
1.6	1.639450	6.270549
1.7	1.633865	6.276134
1.8	1.625612	6.284387
1.9	1.615002	6.294997
2	1.602317	6.307682
2.1	1.587812	6.322187
2.2	1.571717	6.338282
2.3	1.554238	6.355761
2.4	1.535566	6.374433
2.5	1.515867	6.394132
2.6	1.495297	6.414702
2.7	1.473991	6.436008
2.8	1.452075	6.457924
2.9	1.429659	6.480340
3	1.406844	6.503155

File : DM1

DOWNSTREAM MARCH

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*****************************************************************************
                    RIVER AND WATER CHARACTERISTICS

Flow 3 , cu.m./sec           =  486.744 * DO 3 , mg/l            =      4.11
Flow 4 , cu.m./sec           = 448.0517 * DO 4 , mg/l            =       3.8
Distance , Km.               =    13.25 * ult.BOD 3 , mg/l       =       3.7
Time , day                   = 0.114388 * ult.BOD 4 , mg/l       =      3.92
Velocity(avg) , m./sec       = 1.340666 * DOsat.3 , mg/l         =      8.33
Water temperature 3 , 'c     =       24 * DOsat.4 , mg/l         =      8.33
Water temperature 4 , 'c     =       24 * DOsat.(avg) , mg/l     =      8.33

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k1 = 0.095 /day
k2 = 0.128 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	4.394670	3.935329
0.02	4.385612	3.944387
0.04	4.376535	3.953464
0.06	4.367437	3.962562
0.08	4.358321	3.971678
0.1	4.349186	3.980813
0.12	4.340032	3.989967
0.14	4.330861	3.999138
0.16	4.321672	4.008327
0.18	4.312467	4.017532
0.2	4.303244	4.026755

File : DM2

DOWNSTREAM MARCH

****

RIVER AND WATER CHARACTERISTICS

Flow 4 , cu.m./sec	= 448.0517	*	DO 4 , mg/l	=	3.8
Flow 5 , cu.m./sec	= 604.3053	*	DO 5 , mg/l	=	5.78
Distance , Km.	= 21.01	*	ult.BOD 4 , mg/l	=	3.82
Time , day	= 0.212500	*	ult.BOD 5 , mg/l	=	3.[illegible]7
Velocity(avg) , m./sec	= 1.144333	*	DOsat.4 , mg/l	=	8.33
Water temperature 4 , 'c	= 24	*	DOsat.5 , mg/l	=	8.16
Water temperature 5 , 'c	= 25	*	DOsat.(avg) , mg/l	=	8.255

****

k1 = 0.086 /day
k2 = 0.39 /day

Time (day)	Deficit (mg/l)	DO (mg/l)
0	3.857387	4.397612
0.02	3.801802	4.453197
0.04	3.747154	4.507845
0.06	3.693428	4.561571
0.08	3.640607	4.614392
0.1	3.588675	4.666324
0.12	3.537617	4.717382
0.14	3.487416	4.767583
0.16	3.438059	4.816940
0.18	3.389530	4.865469
0.2	3.341815	4.913184
0.22	3.294900	4.960099

File : CO1

CORRELATION OF DEOXYGENATION RATE FROM DIFFERANCE METHOD

MONTH	STATION	(k1)	METHOD			
			LEAST	THOMAS	RHAME	STREETER
JULY	TALEE	0.14	0.142	0.07	0.145	0.142
	HYDRO. STATION		0.136	0.058	0.114	
	BEHIND DAM	0.097	0.097	0.05	0.087	2.24
	BANJUSSON	0.12	0.127	0.058	0.101	0.018
	BANTAK		0.12	0.081	0.103	
SEPTEMBER	TALEE	0.104	0.104	0.045	0.092	-0.236
	HYDRO. STATION		0.103	0.048	0.095	
	BEHIND DAM	0.095	0.094	0.048	0.079	2.022
	BANJUSSON	0.097	0.097	0.057	0.098	-1.048
	BANTAK		0.11	0.056	0.109	
NOVEMBER	TALEE	0.091	0.104	0.056	0.092	0.091
	HYDRO. STATION		0.06	0.052	0.09	
	BEHIND DAM	0.051	0.055	0.051	0.052	0.051
	BANJUSSON	0.088	0.08	0.077	0.063	-2.77
	BANTAK		0.083	0.088	0.079	
MARCH	TALEE	0.098	0.091	0.069	0.03	0.098
	HYDRO. STATION		0.093	0.045	0.087	
	BEHIND DAM	0.095	0.094	0.047	0.094	0.095
	BANJUSSON	0.086	0.085	0.047	0.078	-0.493
	BANTAK		0.09	0.056	0.088	

REMARK : (k1) = k1 which accept

File : CO2

CORRELATION OF REAERATION RATE FROM DIFFERANCE METHOD

MONTH	STATION	(k2)	METHOD			
			CHURCHILL	ISAACS'	OWENS	STREETER
JULY	TALEE	0.38	1.814	1.322	2.007	0.094
	HYDRO.STATION		1.901	1.397	1.988	
	BEHIND DAM	0.33	0.437	0.392	0.341	4.904
	BANJUSSON	0.38	0.284	0.235	0.312	0.24
	BANTAK		0.385	0.316	0.412	
SEPTEMBER	TALEE	0.42	2.028	1.487	2.139	-2.357
	HYDRO.STATION		2.189	1.631	2.153	
	BEHIND DAM	0.34	0.663	0.507	0.772	21.268
	BANJUSSON	0.36	1.415	0.993	1.842	-7.585
	BANTAK		1.571	1.103	2.02	
NOVEMBER	TALEE	0.168	0.474	0.411	0.4	0.168
	HYDRO.STATION		1.27	0.996	1.184	
	BEHIND DAM	0.31	1.369	1.071	1.276	0.772
	BANJUSSON	0.21	1.436	1.106	1.396	-11.831
	BANTAK		0.56	0.466	0.53	
MARCH	TALEE	0.41	0.53	0.357	0.949	0.415
	HYDRO.STATION		0.878	0.588	1.444	
	BEHIND DAM	0.128	0.235	0.223	0.174	0.128
	BANJUSSON	0.39	0.249	0.235	0.185	0.115
	BANTAK		0.439	0.374	0.398	

REMARK : (k2) = k2 which accept

ประวัติผู้เขียน

ชื่อ	นาย สุเทพ ถิรสัตยาพิทักษ์
การศึกษา	วิทยาศาสตรบัณฑิต (ชีววิทยา)
	คณะวิทยาศาสตร์ มหาวิทยาลัยศรีนครินทรวิโรฒ (สงขลา)
	ปีการศึกษา 2526