



ANNEX



NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETER	UNIT	CLASS				
		I	IIA/IIIB	III [#]	IV	V
Al	mg/l	 N A T U R A L L E V E L S O R A B S E N T 	-	(0.06)	0.5	 L E V E L S A B O V E I V 
As	mg/l		0.05	0.4 (0.05)	0.1	
Ba	mg/l		1	-	-	
Cd	mg/l		0.01	0.01* (0.001)	0.01	
Cr (IV)	mg/l		0.05	1.4 (0.05)	0.1	
Cr (III)	mg/l		-	2.5	-	
Cu	mg/l		0.02	-	0.2	
Hardness	mg/l		250	-	-	
Ca	mg/l		-	-	-	
Mg	mg/l		-	-	-	
Na	mg/l		-	-	3 SAR	
K	mg/l		-	-	-	
Fe	mg/l		1	1	1 (Leaf) 5 (Others)	
Pb	mg/l		0.05	0.02* (0.01)	5	
Mn	mg/l		0.1	0.1	0.2	
Hg	mg/l		0.001	0.004 (0.0001)	0.002	
Ni	mg/l		0.05	0.9*	0.2	
Se	mg/l		0.01	0.25 (0.04)	0.02	
Ag	mg/l		0.05	0.0002	-	
Sn	mg/l		-	0.004	-	
U	mg/l		-	-	-	
Zn	mg/l		5	0.4*	2	
B	mg/l		1	(3.4)	0.8	
Cl	mg/l		200	-	80	
Cl ₂	mg/l		-	(0.02)	-	
CN	mg/l		0.02	0.06 (0.02)	-	
F	mg/l		1.5	10	1	
NO ₂	mg/l		0.4	0.4 (0.03)	-	
NO ₃	mg/l		7	-	5	
P	mg/l		0.2	0.1	-	
Silica	mg/l		50	-	-	
SO ₄	mg/l		250	-	-	
S	mg/l		0.05	(0.001)	-	
CO ₂	mg/l		-	-	-	
Gross-α	Bq/l		0.1	-	-	
Gross-β	Bq/l		1	-	-	
Ra-226	Bq/l		< 0.1	-	-	
Sr-90	Bq/l		< 1	-	-	
CCE	µg/l	A B S E N T	500	-	-	-
MBAS/BAS	µg/l		500	5000 (200)	-	-
O & G (Mineral)	µg/l		40; N	N	-	-
O & G (Emulsified Edible)	µg/l		7000; N	N	-	-
PCB	µg/l		0.1	6 (0.05)	-	-
Phenol	µg/l		10	-	-	-
Aldrin/Dieldrin	µg/l		0.02	0.2 (0.01)	-	-
BHC	µg/l		2	9 (0.1)	-	-
Chlordane	µg/l		0.08	2 (0.02)	-	-
t-DDT	µg/l		0.1	(1)	-	-
Endosulfan	µg/l		10	-	-	-
Heptachlor/Epoxide	µg/l		0.05	0.9 (0.06)	-	-
Lindane	µg/l		2	3 (0.4)	-	-
2,4-D	µg/l		70	450	-	-
2,4,5-T	µg/l		10	160	-	-
2,4,5-TP	µg/l		4	850	-	-
Paraquat	µg/l		10	1800	-	-

Notes :

* = At hardness 50 mg/l CaCO₃

= Maximum (unbracketed) and 24-hour average (bracketed) concentrations

N = Free from visible film sheen, discolouration and deposits

NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETER	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12	> 12
Chemical Oxygen Demand	mg/l	10	25	25	50	100	> 100
Dissolved Oxygen	mg/l	7	5 - 7	5 - 7	3 - 5	< 3	< 1
pH	-	6.5 - 8.5	6 - 9	6 - 9	5 - 9	5 - 9	-
Colour	TCU	15	150	150	-	-	-
Electrical Conductivity*	µS/cm	1000	1000	-	-	6000	-
Floatables	-	N	N	N	-	-	-
Odour	-	N	N	N	-	-	-
Salinity	%	0.5	1	-	-	2	-
Taste	-	N	N	N	-	-	-
Total Dissolved Solid	mg/l	500	1000	-	-	4000	-
Total Suspended Solid	mg/l	25	50	50	150	300	300
Temperature	°C	-	Normal + 2 °C	-	Normal + 2 °C	-	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform**	count/100 ml	10	100	400	5000 (20000) ^a	5000 (20000) ^a	-
Total Coliform	count/100 ml	100	5000	5000	50000	50000	> 50000

Notes :

N : No visible floatable materials or debris, no objectional odour or no objectional taste

* : Related parameters, only one recommended for use

** : Geometric mean

a : Maximum not to be exceeded

WATER CLASSES AND USES

CLASS	USES
Class I	Conservation of natural environment. Water Supply I – Practically no treatment necessary. Fishery I – Very sensitive aquatic species.
Class IIA	Water Supply II – Conventional treatment required. Fishery II – Sensitive aquatic species.
Class IIB	Recreational use with body contact.
Class III	Water Supply III – Extensive treatment required. Fishery III – Common, of economic value and tolerant species; livestock drinking.
Class IV	Irrigation
Class V	None of the above.

DOE WATER QUALITY CLASSIFICATION BASED ON WATER QUALITY INDEX

SUB INDEX & WATER QUALITY INDEX	INDEX RANGE		
	CLEAN	SLIGHTLY POLLUTED	POLLUTED
Biochemical Oxygen Demand (BOD)	91 - 100	80 - 90	0 - 79
Ammoniacal Nitrogen (NH ₃ -N)	92 - 100	71 - 91	0 - 70
Suspended Solids (SS)	76 - 100	70 - 75	0 - 69
Water Quality Index (WQI)	81 - 100	60 - 80	0 - 59

DOE WATER QUALITY INDEX CLASSIFICATION

PARAMETER	UNIT	CLASS				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 – 0.3	0.3 – 0.9	0.9 – 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 – 3	3 – 6	6 – 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 – 25	25 – 50	50 – 100	> 100
Dissolved Oxygen	mg/l	> 7	5 – 7	3 – 5	1 – 3	< 1
pH	-	> 7.0	6.0 – 7.0	5.0 – 6.0	< 5.0	> 5.0
Total Suspended Solid	mg/l	< 25	25 – 50	50 – 150	150 – 300	> 300
Water Quality Index (WQI)		> 92.7	76.5 – 92.7	51.9 – 76.5	31.0 – 51.9	< 31.0

WQI FORMULA AND CALCULATION

Formula

$$WQI = (0.22 * SIDO) + (0.19 * SIBOD) + (0.16 * SICOD) + (0.15 * SIAN) + (0.16 * SISS) + (0.12 * SIpH)$$

where;

SIDO = Subindex DO (% saturation)

SIBOD = Subindex BOD

SICOD = Subindex COD

SIAN = Subindex NH_3 -N

SISS = Subindex SS

SIpH = Subindex pH

$$0 \leq WQI \leq 100$$

Best Fit Equations for the Estimation of Various Subindex Values

Subindex for DO (in % saturation)

$$\begin{aligned} SIDO &= 0 & \text{for } x \leq 8 \\ SIDO &= 100 & \text{for } x \geq 92 \\ SIDO &= -0.395 + 0.030x^2 - 0.00020x^3 & \text{for } 8 < x < 92 \end{aligned}$$

Subindex for BOD

$$\begin{aligned} SIBOD &= 100.4 - 4.23x & \text{for } x \leq 5 \\ SIBOD &= 108 * \exp(-0.055x) - 0.1x & \text{for } x > 5 \end{aligned}$$

Subindex for COD

$$\begin{aligned} SICOD &= -1.33x + 99.1 & \text{for } x \leq 20 \\ SICOD &= 103 * \exp(-0.0157x) - 0.04x & \text{for } x > 20 \end{aligned}$$

Subindex for NH_3 -N

$$\begin{aligned} SIAN &= 100.5 - 105x & \text{for } x \leq 0.3 \\ SIAN &= 94 * \exp(-0.573x) - 5 * |x - 2| & \text{for } 0.3 < x < 4 \\ SIAN &= 0 & \text{for } x \geq 4 \end{aligned}$$

Subindex for SS

$$\begin{aligned} SISS &= 97.5 * \exp(-0.00676x) + 0.05x & \text{for } x \leq 100 \\ SISS &= 71 * \exp(-0.0061x) - 0.015x & \text{for } 100 < x < 1000 \\ SISS &= 0 & \text{for } x \geq 1000 \end{aligned}$$

Subindex for pH

$$\begin{aligned} SIpH &= 17.2 - 17.2x + 5.02x^2 & \text{for } x < 5.5 \\ SIpH &= -242 + 95.5x - 6.67x^2 & \text{for } 5.5 \leq x < 7 \\ SIpH &= -181 + 82.4x - 6.05x^2 & \text{for } 7 \leq x < 8.75 \\ SIpH &= 536 - 77.0x + 2.76x^2 & \text{for } x \geq 8.75 \end{aligned}$$

Note:

* means multiply with

MWQI FORMULA AND CALCULATION

$$MWQI = SI DO^{0.2} \times SI NH_3^{0.16} \times SI FC^{0.14} \times SI TSS^{0.14} \times SI O\&G^{0.13} \times SI NO_3^{0.12} \times SI PO_4^{0.11}$$

where;

SIDO	= Subindex Dissolved Oxygen
SINH ₃	= Subindex Unionized Ammonia
SIFC	= Subindex Faecal Coliform
SITSS	= Subindex Total Suspended Solids
SIO&G	= Subindex Oil and Grease
SINO ₃	= Subindex Nitrate
SIPO ₄	= Subindex Phosphate

$$0 \leq MWQI \leq 100$$

Best Fit Equations for the Estimation of Various Subindex Values

Dissolved Oxygen (DO) in mg/L

For DO between 3 and 7

$$SI(DO) = -85.816 + 55.476(DO) - 4.142(DO)^2$$

If DO is less than 3, or more than 10, SI = 10%

Ammonia (Unionized) (NH₃) in mg-N/L*

$$SI(NH_3) = 100 \exp^{-4.6(NH_3)}$$

* If Ammoniacal Nitrogen (NH₃+N) is measured, convert the value into unionized ammonia.

Faecal Coliform (FC) in MPN/100ml

$$SI(FC) = 100 \exp^{-0.005(FC)}$$

If FC ≥ 500 MPN, SI = 8%

Total Suspended Solids (TSS) in mg/L

$$SI(TSS) = 95.8 \exp^{-0.0043(TSS)}$$

If TSS > 100 mg/L, SI = 20%

Oil & Grease (OG) in mg/L

$$SI(OG) = 98 \exp^{-0.21(OG)}$$

Nitrate (NO₃) in mg-N/L

$$SI(NO_3) = 94.83 \exp^{-0.35(NO_3)}$$

Phosphate (PO₄) in mg-P/L

$$SI(PO_4) = 95.2 \exp^{-0.002(PO_4 \times 1000)}$$

UNIONIZED AMMONIA CALCULATION

In order to convert the concentration of total ammoniacal nitrogen into unionized ammonia, calculate (a), (b), (c) and (d). Substitute the results into equation 1.

a. Calculation of Ionic Strength (IS)

$$IS = \frac{19.9273 * Salinity}{(1000 - 1.005109 * Salinity)}$$

Salinity in part per thousand (ppt)

b. Calculation of PKa

$$PKa = (0.0901821 + \frac{2729.92}{(Temp + 273.15)}) + IS (0.1552 - 0.000314 * Temp)$$

Temperature in °C

c. Calculation of working pH

$$pH_{sw} = pH - (0.0007 * IS) - 0.131$$

d. Calculation of mole fraction for unionized ammonia

$$\text{Mole Fraction} = \frac{1}{1 + 10^{(PKa - pH_{sw})}}$$

Equation:

$$\text{Unionized ammonia} = \text{Total ammoniacal nitrogen} \times \text{mole fraction}$$

Total ammoniacal nitrogen should be measured in µg/l



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ISBN 978-983-9795-29-5



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