Conseil International
pour l'Exploration de la Mer

C.M. 1962
N Hydrographical Committee N° 33

New Table of Chemical Methods and Units

by Mario Picotti

During the 49th Reunion of the Copenhagen's Council, held on October 1961, there were spent two meetings of two under - Committees - in the competence of the Hydrographical Committee - the first one to establish the determination of salinity with standard methods, and the second which have, and still have, the charge of composing a system of rational units for reporting of data in oceanographical chemistry in the international publications of synthetic table models and furthermore to study the insertion of these numerical data also in punched card indexes, that are now under work.

This subject, already examined by the Council during previous meetings also, has a pretty good literature that concerns various proposals relating to these measure units which should be used by all the oceanographs that have given their efficacious cooperation to the programs unrolled during I.G.Y. period.

In this short exposition we will also remember the relating bibliography (sec. 1. 2. 3.).

At the discussion of 1961, during the full setting of the Hydrographical Committee, I have presented a table for the measure units, already published by me on 1955 (2), but with some additions that I was of opinion, since then, necessary.

And, for the 50th meeting, next October, following the agreement taken during previous meetings, I deem it advisable to lay out an entirely remade table, following so the proposals forwarded by several colleagues and also suitable for the continuous, rapid progress and strengthening of the oceanographical chemistry.

Such modifications and additions concern:

1) The definitions of chlorinity and chlorosity proposed by Sverdrup ("The Ocean's a.s.o."pag. 52) according to which the chlorinity of a sea-water sample is identical to the mass in grams of the so called very pure Hönigschmied silver "for atomic - weight" - the mass just necessary to precipitate the halogens contained in kg 0,328.523.3 of sea - water.

Of course this definition results irrespective of alla causal variations of the atomic - weight of silver and of the components of sea - water.

New term chlorosity has been instead introduced to satisfy the requests of those who, to the system weight/weight, prefer that one of weight/volume, and, therefore the chlorosity g/dm^3 results from the simple relationship chlorosity = chlorinity x density at 20° (N.B. not the temperature "in situ").

2) The units of volume, milliliter and liter, (ml and l) have been substituted, (to simplify the definition, for a direct reference with the metric system and for the isotopic composition of the water), with cm^3, and dm^3 respectively.

Their equivalence results by the following relation :

$$1 \ l = 1.000.027 \ dm^3$$

And therefore we have these multiples :

$$1 \ m^3 = 10^3 \ dm^3 = 10^6 \ cm^3$$

It is obvious that for the selected unit of volume, also the temperature of reference of sea - water sample is of 20° c = for the measures of high precision = also the corresponding salinity, therefore 1 l S 20° in corresponding to 1 liter of water with salinity S and a temperature of 20°.

So 1 dm^3 S 20° is equivalent to 1 dm^3 of water with salinity S and a temperature of 20°C.

3) In the series of fundamental (major) elements we have too insert Sr^{+2} F^{-1}.

4) As for organic compounds with a well definite chemical constitution, or for parts of the molecule (particular groups, e. g.: methyl, ethyl, carbonyl, carboxyl a.s.o.) we can do the corrisponding calculation and give this results:
either μg $v\gamma/dm^3$ - or mg/m^3.

In other cases we will limit ourselves to the generical expression of the equivalent value of oxygen (mg, cm^3, a.s.o.) consumed for the oxidation with metod of the permanganate in an acid solution and with addition of some drops of manganese sulphate as catalytic action, as a reaction regulator and for a complete reproducing of the same.

Bibliography

(1) Procés-Verbal de la Réunion 1961 du Conseil Permanent International pour l'Exploration de la Mer, Publié par le Bureau Central, Charlottenbund 1962, pag. 87 et 1960 pag.119.

(2) M. Picotti : Unità di misura della dinamica talassografica in Archivi di Oceanografia e Limnologia Vol. I, 1941, Venezia.

Unità di misura nella dinamica talassografica, ibid. Vol. X, 1955, Venezia.

Chemical Oceanography Methods and Units, short note treating on this problem to 49 Meeting of Council October 1961, Copenhagen.

(3) K. Kalle : Fur Frage der Ferstsetzung der Masseinheiten unter meereskundlichen Chemie. Ann. d. Hydr. u. Marit. Met. Berlin pag. 18, 1935.

(4) Helland Hansen, J.P. Jacoben and E.G. Thompson : Report of Chemical Methods and Unit Assoc. d'Océanographié Physique U.G.G.I. Publication n.9, 1948.

New Table

of Nomenclature, Abbreviation and Units for Indication of the Amount of Constituents of Sea – Water

Elements or definite Chemical Compounds	Unit Expressions used	Different units	Conversion Coefficients
Chlorinity (Cl^-)	g Cl^-/kg (1)	g $Cl^-/dm^3_{20°}$	Conversion – Tables from Weight/Weight to Weight/Volume (17.5) → 17,5° K.Kalle and M. Picotti (12)
Salinity (S)	g Salts/kg	g Salts/$dm^3_{20°}$	S = 0,03000 ‰ + 1,80500 Cl^- Conversion – Tables as, above: K.Kalle and M. Picotti (12)
Chlorosity (Cl^-)	g $Cl^-/l_{20°}$	g $Cl^-/dm^3_{20°}$ (3)	Chlorosity = Chlorinity x Density $_{20°}$ Conversion = Tables as above Corresponding Values of Chlorinity and Chlorosity after Sverdrup: Chlorinity ‰ 15.00 16.00 17.00 18.00 19.00 20.00 21.00 Chlorosity g l^{-1} 15.28 16.32 17.37 18.41 19.46 20.51 21.57
Major Constituents a) Cations Na^{+1} K^{+1} Mg^{+2} Ca^{+2} Sr^{+2}	g/kg	g-atoms/kg	from Na_2O K_2O MgO CaO SrO to Na K Mg Ca Sr 0,7419 0.8301 0,6032 0,7147 0.8456 and to g-atoms 0,4339 0.2555 0.4105 0.2498 0.1141
b) Anions Cl^{-1} Br^{-1} F^{-1} SO_4^{-2} HCO_3^{-1}	g/kg	g-anions/kg and for carbonates eventual cm^3 total CO_2 (NTP)(2) for $dm^3_{20°}$ (3)	from SO_3 SO_4^{-2} H_2SO_4 CO_2 HCO_3^{-1} CO_3^{-2} CO_2 (cm^3) to S S S C C C CO_2 (mg) 0.4004 0.3269 0.1968 0.3338 0,2729 0.2001 1.9768 and to g-mol 0.03119 0,08334

Elements of definite Chemical Compounds	Unit Expressions used	Different units	Conversion Coefficients
Minor elements a) Metals (Cations) Al Fe Mn Cu ecc.	$\mu g/dm^3_{S.20°}$ (4) or $mg/m^3_{S.20°}$	μg-atoms/$dm^3_{S.20°}$ or mg-atoms/$m^3_{S.20°}$	for Al_2O_3 Fe_2O_3 MnO_2 CuO to Al Fe Mn Cu 0.5291 0.6994 0.6319 0.7989 and to g - atoms 0.0369 0.0179 0.01828 0.01573
b) Metalloids (Anions) Si, P (total, phosphate dissolved, Organic Compounds, plankton ecc.), As, B	" "	" "	for SiO_2 H_2SiO_3 P_2O_5 H_3PO_4 As_2O_3 As_2O_5 H_3BO_3 Si Si P P As As B 0,4672 0.3584 0.4365 0.3161 0.7574 0.6519 0.1774 and to g - atoms 0.03164 0.03223 0.01334 0.09091
Nitrogen and " Compounds	1) Total Nitrogen $\mu g/dm^3_{S.20°}$ or $mg/m^3_{S.20°}$	μg-atoms/$dm^3_{S.20°}$	for NH_3 (NH_4^+) N_2O_3 NO_2^- N_2O_5 NO_3^- to N N N N N N 0.8225 0.7765 0.3685 0.3045 0.2594 0.2259 and to g - atoms (N) 0.0714
	2) Ammonia-Nitrogen N (NH$_4^+$) μg or mg as above	" "	
	3) Nitrite-Nitrogen N (N_2O_3) as above	" "	
		" "	
	4) Nitrate-Nitrogen N (N_2O_5) as above	" "	

Hydrogen-Ion Concentration	S.P.L. Sörensen pH - Exponent (5) $pH = \log \frac{1}{(H^+)}$		$p H_t = - \log \frac{g - atoms(H^+)}{dm^3_{20°}}$
Dissolved Gases in Sea Water	cm^3 gas (NTP) $dm^3_{S,20°}$ and for Oxygen also $\frac{100 - O_2 \%}{O'_2}$ (6)	μg - atoms/$dm^3_{S,20°}$	1 g O_2 N_2(7) CO_2(8) H_2S(9) 700 799.7 505.9 649.7 cm^3 (NTP)
Organic Conpounds	mg O_2/ $dm^3_{S,20°}$ (10)	cm^3 Oxyding-solution n/10 or n/100 ($KMnO_4$)	
Alkalinity (excess-base)	mg-atoms ionized Hydrogen (millivals) necessary for neutralization 1 $dm^3_{S20°}$ water) (11)	millival/$dm^3_{S,20°}$	H = 1,008

(1) Chlorinity and chlorosity and salinity is defined and the appropriate technique was established from Knudsen Sörensen Jacobsen and Sverdrup.

(2) (NTP) quantities of gases are expressed in cm^3, at 0°C and at a pressure of 1 atmosphere (760 Hg colum of mercury at 0°, acceleration 980.665 cm/s^2 45° N. Lat so-called "Physical atmosphere").

1 physical atmosphere (Atm) = 760 Torr = 1.0133 bar = 1.0133 x 10^3 millibar = 1.0133 x 10^6 dyn/cm^2.

(3) 1 $dm^3_{S,20°}$ = 1 dm^3 Sea - Water from S salinity at 20° temperature.

(4) 1 ton = 10^3 Kilograms (Kg) = 10^6 grams (g)

1 gram = 10^3 milligrams (mg) = 10^6 mygrams (μg) or 10^6 gamma (γ).

(5) pH corrected from the effect of temperature and salinity error.

(6) $\frac{100 \times O_2}{O'_2}$ % Relative Oxygen saturation.

(7) Nitrogen + Inert Gase.

(8) Total Carbon Dioxid; Free Carbon Dioxid amount mg-atoms/$dm^3_{S,20°}$ and Carbon Dioxide - Pressure (the exchange of carbon dioxide between air and sea-water at an equal temperature se-water/air system), the pressure has to be reported as P_{CO_2} Torr.

hyll, Carbonyl, Carboxil - Groups) we will use: either ug/dm$^3_{S.20°}$ or mg/m$^3_{S.20°}$.

the pH to about 4.5.

ndlichen Chemie Ann. d. Hydrogr. u.Mar.Metor. Berlin,1935.

Oceanografia e Limnologia,Volume X/3 Venezia,1955.