Sir John Murray & Johan Hjort, The Depths of the Ocean: Scientific Researches of the Norwegian Steamer Michael Sars (1912)

The numerous other substances in solution are present in such extremely small quantities that they may be disregarded. Although the total salinity may vary widely, the composition of the dissolved solids proves to be practically the same everywhere. Hence if in a sea-water the percentage of any one component, say chlorine, be known, the total salinity can be ascertained by calculation.

Determination of salinity.

The direct determination of salinity by evaporating a known volume of water to dryness does not give accurate results, unless the amount of chlorine is carefully determined before and after the evaporation, because in the last stages of evaporation and in drying the residual salt uncertain amounts of chlorine are disengaged in the form of hydrochloric acid. Such a determination is very circumstantial, and it is therefore necessary to resort to indirect methods, which may be physical or chemical.

Physical methods.

An old-established physical method consists in determining the density by means of the hydrometer. This is a glass cylinder which floats in the water and has a graduated stem, on the scale of which densities are read off. The temperature of the water must be determined at the same time. Densities so found are recalculated by means of tables to a standard temperature, generally 17.5° C. Now, owing to the uniform composition of sea-salts, a definite density at 17.5° corresponds rigidly to a definite salinity. Hence by referring to tables the salinity of a sea-water can be found from its density at standard temperature.

The hydrometric method is easily applied on board ship, and may be made to give densities correct to four places of decimals. Densities can be determined to a yet higher degree of accuracy by means of the pycnometer, but this method is practicable only in a laboratory on land, and is not often employed.

Two other physical methods have been tried by way of

errors have been detected in earlier determinations referable to the leaky condition of the water-bottles.

When the forms of apparatus described above are to be used, the vessel must be stopped and hove to as long as the work goes on. Recently several investigators have studied the problem of constructing an apparatus to be used while the ship is under way. Water-bottles have been made which can be let out when the ship is going at full speed, with the line running freely so as to allow them to sink. On checking the line the apparatus is closed by a mechanism like that used by Buchanan in his water-bottle. The water-bottle being insulating, a temperature-reading is secured together with the water-sample. In such an experiment a metre-wheel showing how much line has run out is no use; one must have a special depth-gauge, usually one to measure the compression suffered by a certain volume of air from the weight of the water. These new instruments are not in common use as yet, being still in the experimental stage, but the time is not far off when we shall have automatic water-bottles working with absolute precision. That will mark an important step forward, as much time will then be saved in an expedition.

http://19thcenturyscience.org/HMSC/HMSC-Reports/1912-Murray/README.htm