

SHORT NOTES

A SALINITY INDICATOR FOR USE IN MARINE FISH FARMING

INTRODUCTION

In marine fish farming there is a need for a low cost instrument to enable salinity to be measured quickly and simply, without the complexity and expense normally associated with oceanographic salinometers. The limited accuracy required has made it possible to construct an enclosed, direct reading instrument which is extremely simple to operate. As the overall accuracy is

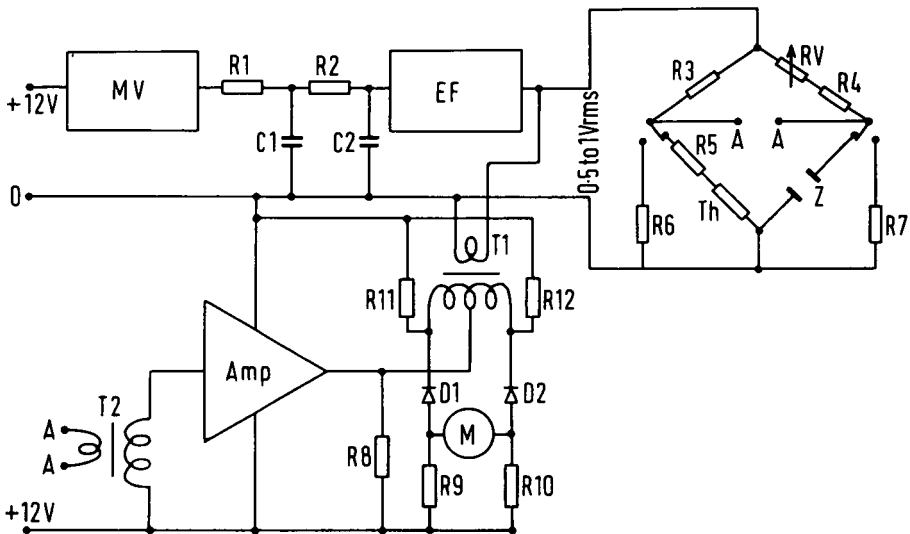


Figure 1. Circuit diagram for the salinity indicator.
MV, multivibrator; EF, emitter, follower.

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|--------------|--|--------------|---|
| R 1 | 500 Ohms | C 1 | 0.1 μ F |
| R 2 | 1 K Ohm | C 2 | 0.1 μ F |
| R 3 | 260 Ohms | D 1 and D 2, | good quality silicon diodes |
| R 4 | 10 Ohms | T 1 | 3.6 : 1 + 1 split secondary A.F. transformer |
| R 5 | 75 Ohms approx. (select for best overall temperature compensation) | T 2 | 1 : 1 A.F. Transformer |
| R 7 and R 6, | select for suitable check reading | Th | Thermistor S.T.C. F.S.22B |
| R 8 | 4.7 K Ohms | M | 25-0-25 μ A 1250 Ohm centre zero meter |
| R 9 | 2.2 K Ohms | RV | 100 Ohms variable resistor. Wire wound 1 watt |
| R 10 | 2.2 K Ohms | Z | Conductivity cell. Carbon electrode dip type. Electronic Switch Gear Ltd. Type CD/10B |
| R 11 | 100 K Ohms | | |
| R 12 | 100 K Ohms | | |

$\pm 0.5\%$, the title salinity indicator is considered more appropriate than salinometer.

DESCRIPTION

The instrument is based on a direct conductivity measurement using a carbon electrode dip-cell, temperature compensated by a thermistor in a Wheatstone bridge arrangement (HAMON, 1956). Instead of balancing the bridge manually the bridge resistors are fixed, and the out of balance current is made to indicate conductivity and hence salinity. The supply voltage to the bridge circuit must be AC at a frequency of about 1 KHz to avoid polarisation and it is difficult to achieve a high enough voltage stability with simple audio frequency oscillators. Several oscillator circuits have been considered but the only simple one that gave the required long-term voltage stability was the astable multivibrator, and therefore this circuit has been adopted.

The bridge supply circuit (Fig. 1) consists of two silicon transistors in a standard multivibrator circuit, the collector output of one transistor being fed via an emitter-follower to the bridge supply point. A simple resistance-capacity filter is included between the collector output and the emitter-follower to remove some of the harmonics from the square wave output of the multivibrator. In practice the fact that the bridge is not supplied with a pure sine wave does not give rise to any problems. The voltage at the terminals of the bridge is about 0.8 Vrms and the frequency 1 KHz. As the 12 volt DC supply to the multivibrator and emitter-follower is stabilised, and the maximum possible change of collector voltage when the relevant multivibrator transistor is saturated is in the order of millivolts the amplitude of the resultant square wave is sufficiently stable for the calibration of the instrument to hold good over a long period of time.

The output signals from the bridge are fed to an audio frequency amplifier which incorporates a high degree of negative feedback giving sensibly constant gain over a wide range of operating conditions. The gain is preset and forms a sensitivity control when initially setting up the bridge. The output of the amplifier feeds a phase sensitive transformer/rectifier system which gives a DC signal to a centre zero moving coil meter. The meter is scaled from 20 to 33 p.p.t. with 25 p.p.t. on mechanical zero of the meter.

The design of the multivibrator and amplifier is not critical and conventional circuits are used. The power supply consists of two 9 volt dry batteries in series and a zener diode/emitter-follower stabiliser unit.

A check switch is incorporated in the bridge circuit which substitutes fixed resistors for the thermistor and conductivity cell. By arranging the resistors to slightly unbalance the bridge and give a standard reading on the meter, a check on all parts of the circuit except the thermistor and cell is instantly possible.

There are no manual operations to carry out to obtain a reading and the instrument is in a box with a perspex lid, the only outside control being a push button On-Off switch recessed into the side. To take a reading the operator simply immerses the cell, complete with thermistor, in the water to be tested and presses the button on the side of the box. The salinity is indicated on the meter scale.

The instrument has been in daily use, in all weathers, for over a year and

the calibration has been found to hold good for several months before any resetting is required.

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PHYTOPLANKTON STUDY - AN APPRAISAL

On the eve of retirement, it is interesting to reflect on the work done, its significance, and the approach one would make to the same problems today. I would like, therefore, to consider my own phytoplankton studies, in the light of results to date, and the modern equipment now available.

I have made all my quantitative studies of phytoplankton by counting, using the fluorescence method that I outlined in 1962 (FERGUSON WOOD, 1962). I preferred this to chlorophyll estimations or to carbon-14 estimates of assimilation because I believed that I could get more information of actual plant material and the constitution of the plant community. I felt that the difficulties of interpreting chlorophyll results were very great, and that it was probable that ^{14}C measured standing crop rather than production because of the large alterations in conditions of assimilation caused by placing samples in small bottles and testing them for a limited time. I discarded the Utermöhl method because it required preservative, and all preservatives I tried, including Lugol's iodine, caused great damage to the naked flagellates which, in certain waters, dominate, and in many other waters, form a very significant part of the plant material in the photic zone. Fortunately, I resisted the temptation to improve my method, and kept to the original idea that a constant method would allow comparisons of water masses and seas that could, with sufficient data, be computerized. These decisions, I do not regret.

In all instances, samples were taken at fixed depths to 150 or 200 m, and the phytoplankton counts at the several depths were accompanied by information on temperatures, salinities and usually nitrates, phosphates, oxygen, ^{14}C and chlorophyll. I have always believed that as much chemical and physical data as possible should be collected concomitantly with any phytoplankton samples. As a result, I have now phytoplankton records together with a large amount of data regarding the habitat, from the Indian Ocean east of 90°E , the south-west Pacific to 180°E , and the Antarctic, making a continuous record from the equator to the Antarctic continent in both Indian and Pacific Oceans, as well as the tropical and subtropical western Atlantic.

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