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# SECCHI DISC — CHLOROPHYLL RELATIONSHIPS

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ABSTRACT

Secchi disc - Chlorophyll relationships are studied and an equation is presented after least square analysis to predict Chloropnyll concentrations for varying secchi disc depths. Its validity in sediment dominated waters is also discussed along with some limitations.

## INTRODUCTION

THE OCEANOGRAPHIC community has long attempted to characterise water quality parameters by optical methods. A quick field measurement of turbidity, though admittedly crude, may be obtained by the use of a secchi disc. The secchi disc of 30 cm diameter with alternating quaters painted white and black is lowered into water and the depth of water at which it is no longer distinguishable with naked eye is termed the secchi disc depth (SD). This depth decreases as the total attenuation coefficient of water increases due to both absorption and scattering. There is a theoretical and practical correlation between turbidity and secchi depth, because the amount of material in the water affects the light attenuated in both cases. This is an inverse relationship, with SD increasing with decreasing turbidity.

The presence of chlorophyll influences the optical characteristics, thus producing a change in the water colour. This has led many workers to relate secchi depth to the chlorophyll concentrations and vice-versa. The obvious reason for quantifying chlorophyll is that it forms the first link in the marine food chain which eventually determines the fertility of the waters examined.

Carlson (1977) has proposed a trophic index for lakes that is based upon transparency of water as measured by the secchi disc. He proposed an index wherein the secchi depth is a power function of chlorophyll concentrations and therefore algal population densities. Lorenzen (1980) criticised the index, because it neglects the effects of substances other than algae that attenuate subsurface light.

In case 1 waters, *i.e.* Ocean waters where the optical properties are totally governed by phytoplankton and its immediate derivatives, this index should hold good. This implies that for waters with high suspended sediment content and terrigenous influx the index may result in misleading projections, requiring the assessment of individual factors contributing to the total extinction coefficient.

In this study, an attempt has been made to study secchi disc-chlorophyll relationships. An equation has been presented after performing least square analysis for predicting chlorophyll concentrations with varying secchi depths.

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## MATERIAL AND METHODS

Secchi depths and chlorophyll concentration data were collected for 16 points off Visakha-

patnam, during the months of May and October, 1987. Sampling was planned so as to encounter both high and low concentrations of chlorophyll. In the present study the influences of substances other than phytoplankton were negligible. Acetone-extract method was used for chlorophyll analysis. Based on observed chlorophyll concentrations and secchi disc depths and after performing least square analysis an equation was developed as follows :

$$Z_{SD} = A\ (\text{chl } a)^{B}$$

Where $Z_{SD}$ = secchi disc depth and A and B are the coefficients obtained through least square analysis. A and B were computed to be 4.5169 and —0.4356 respectively.

relationship holds good for values of chlorophyll concentration ranging 0.1 to 2.5 mg/m$^3$ (correlation coefficient 0.91). This relationship obtained can be used to predict changes in chlorophyll concentration with an accuracy of 96% thereby algal biomass. Carlson (1977) developed an equation which predicted that a linear relationship should exist between inverse of secchi disc transparency (1/SD) and other biomass indicators. Lorenzen (1980) and Megard *et al.* (1980) suggest that the attenuation of light by non-algal substances adequately account for deviations from simple light attenuation models. This is true in case 2 waters, where in addition to chlorophyll, suspended sediments and detritus contribute to total extinc-

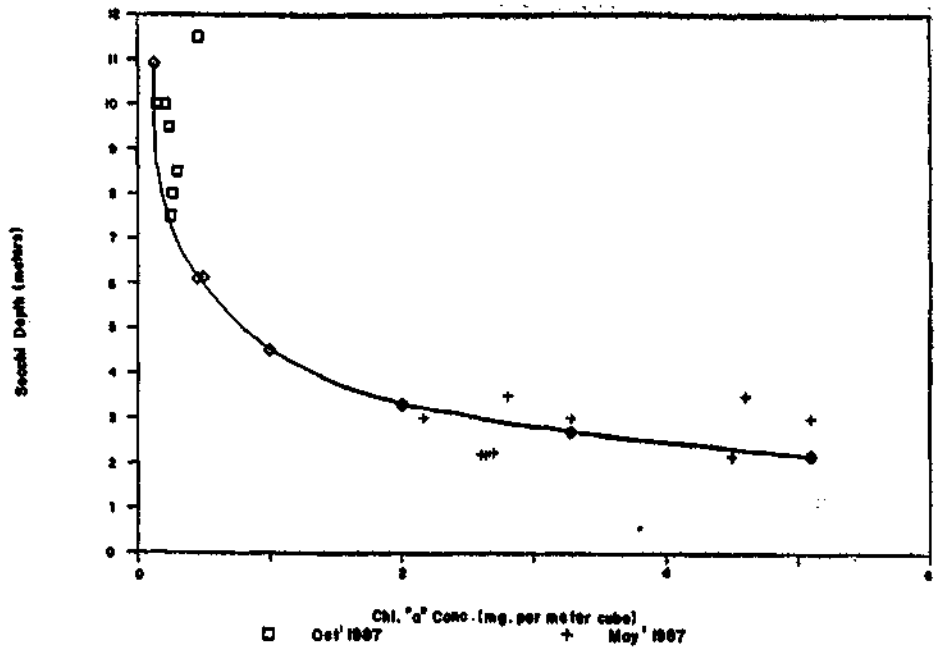


FIG. 1. Relationship between chlorophyll and secchi disc depth.

## RESULTS AND DISCUSSIONS

Based on the least square analysis a curve has been plotted showing the relationship between chlorophyll and secchi depth (Fig. 1). It can be observed that secchi depth — chlorophyll tion coefficient, necessitating computation of extinction coefficients in each individual case.

The study can be extended in these waters assuming that secchi depth can be approximated by the depth of 10% surface light where

secchi disc depth ($Z_{SD}$) can be expressed as follows :

$$Z_{SD} = \frac{-\log(0.10)}{a_w + a_c^* c_1 + a_n^* c_2}$$

Here extinction coefficient is treated as absorption coefficient while scattering coefficient is negligible.

Where

$Z_{SD}$ = secchi disc depth,

$a_w$ = absorption coefficient of water,

$a_c^*$ = specific absorption coefficient of chlorophyll

$a_n^*$ = specific absorption coefficient of non-chlorophyllian particles,

$C_1$ = concentration of chlorophyll mg/m$^3$ and

$C_2$ = concentration of non-chlorophyllian particles mg/l

Specific absorption coefficient of chlorophyll is well established. If specific absorption coefficient of non-chlorophyll particles can be computed the chlorophyll-secchi disc relationship can be established accurately for sediment dominated waters.

The subjectivity involved in secchi depth measurements cannot of course be overlooked. The relationship assumes that the sea is calm and there is no sun light during measurements. As secchi depth observations involve the human eye and variation in vision from person to person, it may sometimes lead to misleading projections. This can be partly be overcome if an average of the secchi depth measurements recorded by more than one scientist at a particular sampling site, is taken for interpretation. Despite some practical limitations secchi disc —chlorophyll relationship can still be meaningful when considering case 1 waters. Although for chlorophyll concentrations over 2.5 mg/m$^3$, there is very little change in the secchi depth, this cut-off limit serves the purpose when interpreting the fertility of these waters.

Therefore it can be emphasized that in the absence of water sampling for chlorophyll, secchi depth measurements can give a rough indication of the chlorophyll concentration and therefore algal population densities and still has an useful place in characterizing water quality parameters. Secchi transparency can be used meaningfully to interpret long term changes in phytoplankton abundance, turbidity and as a trophic state indicator.

## References


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