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The Antifouling of ACLW-CAR Based on Ultrasonic Cleaner

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Abstract. Equipped with ACLW-CAR, the buoy provided effective technical platform for on-site rapid monitoring of the chlorophyll and turbidity. Performance index and usage in the ocean buoy of ACLW-CAR was introduced. Ultrasonic cleaning method in seawater was developed for preventing ACLW-CAR from biofouling. Marine chlorophyll and turbidity data can serve for oceanographic research and marine resource exploitation.

1. Introduction

In situ continuous measurement for the chlorophyll and turbidity is an important part of the marine environment monitoring [1-2]. Equipped with ACLW-CAR produced by the JFE Advantech Computer, ocean buoy works automatically to observe the chlorophyll and turbidity data, and transmits these data to shore data center by Beidou system. Ultrasonic cleaner, as a new device, can prevent the ACLW-CAR from biofouling. The buoy for on-site rapid monitoring of chlorophyll and turbidity provides effective technical platform.

2. Chlorophyll and Turbidity Monitoring System

As shown in Figure 1, the chlorophyll and turbidity monitoring system can be divided into sensor system, main control system, Beidou system, data center system and power system.

Figure 1. Block diagram of the chlorophyll and turbidity monitoring system
3. Technical Indicators of ACLW-CAR

ACLW-CAR is a chlorophyll and turbidity meter for a long term observation with a wiper that cleaned the dirt on the optical sensor. It adopts LED in the chlorophyll and the turbidity sensor luminescence part as a source of light. Especially, because the stability in the low density level is good, and the correlation is high with SS in a high density level, the turbidity sensor is suitable for an investigation not only in the sea area but also in the dam and the river. The communication protocol between sensor and PC is RS232C standard. Name of parts is shown in figure 2 [3].

![Figure 2. Name of parts](image)

This equipment has thermistor type temperature sensor. This is very stable and biofouling can’t effect the result of observation. But heavy biofouling makes the response of sensor slow down. Please clean up the sensor regularly. And be careful not to break it, this is a narrow and weak parts [3]. Sensor specifications are shown in table 1[3].

| Parameter       | Sensor type          | Range                | Accuracy                | Resolution |
|-----------------|----------------------|----------------------|-------------------------|------------|
| Chlorophyll     | Fluorescence light   | 0~400µg/L (Uraninite)| Linearity±1% (0~200µg/L)| 0.01µg/L   |
|                 | Scattering           |                      |                         |            |
| Turbidity       | Infrared back-       | 0~1000FTU (Formazine)| ±0.3FTU or 2%           | 0.03FTU    |
|                 | scattering           |                      |                         |            |
| Temperature     | Thermistor           | -5~45°C              | ±0.02°C                 | 0.001°C    |

Communication format of RS232 on ACLW-CAR is shown in table 2 [3].
Table 2. RS232 Communication setup

| Parameter              | Value                        |
|------------------------|------------------------------|
| Baud rate:             | 38400bps                     |
| Length of character:   | 8 bits                       |
| Stop bit:              | 1 bit                        |
| Parity:                | None                         |
| Character type:        | ASCII                        |
| A/D conversion:        | 16-bit A/D converter         |
| Parameters             | Chlorophyll, Turbidity Temperature |
| Power                  | DC 12V-DC24V                 |
| Power consumption:     | 60mA (DC12V, on observation) |

4. Application in Ocean Buoy

Connect wires and set up options correctly otherwise it can’t communicate. Misinput of command line and too short interval between commands may cause wrong work. If there is not enough interval the equipment doesn’t work properly. If there is not enough interval, wiper may stop moving on the way and do not move again until make maintenance. This equipment can’t make proper observation during the wiper is moving[3].

The main control sends commands to ACLW-CAR by the following C statements for start wiping.

`ComPutChar(COM, wipe, 0);`

The main control sends commands to ACLW-CAR by the following C statements for get data.

`ComPutChar(COM, pval);`

The main control sends commands to ACLW-CAR by the following C statements for set serial NO.

`ComPutChar(COM, headR, 02);`

The main control sends commands to ACLW-CAR by the following C statements for get temperature constant.

`ComPutChar(COM, headR, 30);`

The main control sends commands to ACLW-CAR by the following C statements to get chlorophyll constant.

`ComPutChar(COM, headR, 31);`

The main control sends commands to ACLW-CAR by the following C statements for get turbidity constant.

`ComPutChar(COM, headR, 32);`

The main control sends commands to ACLW-CAR by the following C statements for get power constant.

`ComPutChar(COM, headR, 33);`

Figure 3 is the flow diagram of ACLW-CAR.
5. Ultrasonic cleaner for ACLW-CAR

Biofouling, the generic name given to the undesired biological adhesion to surfaces, has been a staple mark for ACLW-CAR since its very beginning. The biofouling of ACLW-CAR has resulted in the unstable or even none operation of system. A variety of approaches for inhibiting biofilm formation have been proposed. The use of toxic compounds within protective coatings has been a common practice in the past, but their adverse environmental impact is now limiting the appeal of such strategy [4].

Along with high intensity ultrasonic development, ultrasonic cleaning already has been widespread in more and more application production and life. The principle of ultrasonic cleaning is to come into being cavitation effect[5]. Figure 4 is installation instruction of ACLW-CAR and its ultrasonic cleaner. The supersonic cleaner mainly includes three parts: supersonic generator, supersonic transducer and plate sound source. Plate sound source driven by transducer creates ultrasound waves over against the ACLW-CAR. This cleaner can prevent the ACLW-CAR from biofouling and is very significant for ocean monitoring field. As can be seen from figure 5, the ACLW-CAR is clean after running for one year. It is prove that ultrasonic cleaner can prevent the ACLW-CAR from biofouling effectively.
6. Summary
The real-time monitoring and measurement of the marine chlorophyll and turbidity is the main content for marine scientific expedition, protection of the marine environment, marine environmental assessment, the development of marine engineering, marine disaster prevention and mitigation and military oceanography are all regarded it as an important parameter. The performance parameters and the computational formulas of the ACLW-CAR were introduced in detail. Ultrasonic cleaner was developed for preventing ACLW-CAR from biofouling. Ocean current buoy for on-site rapid monitoring of current provide effective technical platform.

7. Acknowledgement
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