LABHOUSE APPLICATION ABSTRACT

TOC Testing: The ideal technique to measure organic loading far quicker, more reliably and is perfectly suited for continuous monitoring

Introduction

In accordance with local government regulations, industry must monitor the organic loading of its wastewaters before discharging them into public waterways. Industries heavily affected by this are the Food and Beverage and related industries. To determine the tariffs to be imposed on companies that are over specification on regulations, municipalities currently utilize COD test results, a lengthy and inaccurate method for organic load testing. If used by industry, this COD analysis is a very ineffectual management tool, as the test must be performed in a laboratory and can take 2 to 5 hours for a result - frequently too late to amend any high specification effluent loading. Many companies thus choose not to do this testing due to the frequency of sampling required and due to the high costs of testing. These companies often have to accept the COD results that municipalities provide on their waters

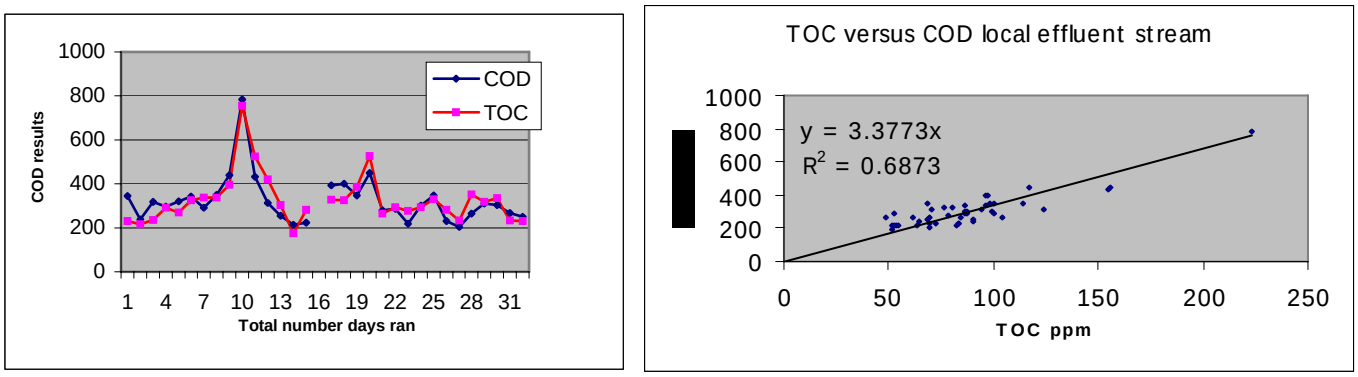

***Figure 1:** Correlations between TOC and COD for local effluent stream (COD = 3.38xTOC)*

and as a result are thus unable to question the tariffs with any other faster and more cost effective tests they could have done. Amounts from 1 to 9 million Rand per annum are often billed to these companies, with serious impacts on profitability. The question is thus two fold: Is there a faster, more accurate test that can provide a reading of organic loading on a continuous basis, and secondly, would the local authorities accept results from an alternative method?

International trends on TOC

Total Organic Carbon (TOC) analysis is a direct measurement of carbon in waters. TOC analysis follows the simple procedure of the oxidation of all organic carbon into CO_2 and this is then detected and equated to ppm carbon. Because of this, the use of TOC as a parameter for measuring the organic loading of wastewater has become increasingly popular in many countries worldwide. This methodology has been around since the 1970's and because of the simplicity of TOC analysis compared to COD analysis and the availability of reliable cost-effective instruments for both laboratory and on-line applications, more users are switching over to TOC as their standard method of analysis. Due to the growing preference of industry users of TOC as their measuring parameter, governments in many European countries are being criticized for their reluctance to let go of the old-fashioned, unreliable and time-consuming COD analysis methods. Responding to such pressures the German authorities for example, in 1998, have changed their regulations (BGB1.1, pg 3919) to allow TOC measurements as a valid indicator for COD. The rest of the EU have followed suite, particularly the UK Environment Agency with specific regards to the Food and Beverage industry. Even in Ireland the discharge licenses are already set in TOC. It is only a matter of time before South Africa would have to follow suite with current local pressure and the acceptance of newer, superior methodology.

Advantages of continuous TOC monitoring

Besides the pending legality of TOC in South Africa, the use of TOC is an indispensable tool for anyone serious about monitoring their effluent discharge or those considering upgrading their effluent treatment processes. In fact, it must be very difficult if not impossible without this ability to know if the effluent treatment process is working effectively. An on-line TOC is thus able to continuously monitor the effluent stream 24/7 and in real-time. Neither the 2 to 5 hour wait, nor the hassle of infrequent sampling times are a problem anymore. The further good news is that TOC does correlate very effectively with COD results for a particular effluent type, making limit setting very easy. Typically TOC is one half to one sixth that of COD results. Local industry users of the technology have been bold in their challenges of municipal COD results when their TOC results suggest otherwise. The undisputable advantages of the technique has prompted some local municipalities to average their COD results with client TOC results to use that value to impose tariffs. A precedent has perhaps been set. There are also distinct advantages with on-line TOC for those companies either reluctant or unable to set up their own lab for COD testing. The costs of setting up a lab and employing lab staff can be very prohibitive. An on-line TOC system does not require a laboratory for operation and needs only monthly reagent replacement. The benefits with this alternative become very attractive.

Cost effectiveness of a TOC system

The cost of a TOC system versus reducing the annual tariff rates can make the return of investment very attractive. A simple calculation comparing the cost of a TOC system with the saving on effective monitoring can make the return on investment within a few months utilizing the following example. An on-line TOC system that costs approximately 250K compared to the annual tariff paid of about 3 million, then the gains of having an effective monitoring system could easily reduce the loading by a modest 10%, resulting in the system being paid for within one month. Imagine the tremendous saving when the high organic loading release is accidental (e.g. poor CIP control) and can be diverted immediately because of real-time detection. Internal accountability becomes possible by having a complete 24 hour picture, compared to a daily COD result. An on-line TOC system will obviously not totally eliminate tariff costs, but can give Production Engineers an invaluable tool for problem solving and effective treatment by understanding the problem on a 24 hour basis. They may find that they would still need to invest in an improved effluent treatment process, but at least this can be done with the correct data. The treatment system can be designed on the actual loading and thus save costs with this investment with proper prior planning. This would not have been possible if it was based on limited COD data.

Other advantages of TOC over COD testing

The major advantage of TOC over other techniques is the speed of analysis. Lab systems can do a sample within 10 minutes and on-line analysers can give readings continuously with only a 4 minute lag. The other major advantage is that TOC is the only generic test for carbon. It does not give false positives or false negatives as the COD test may. The reason for this is that ferric ions, for example, can give a positive COD even when no organics are present. High salt solutions retard the COD digestion process giving lower than expected COD's. Not an ideal analytical method when a dispute arises. Also the cost per test on COD is very expensive compared to TOC, often being between 20 and 40 times that of TOC! Other advantages are that TOC is a far more precise method (typically 2% RSD), so results should be more in agreement with each other; The reagents used in COD are extremely hazardous and environmentally difficult to dispose. With TOC having an advantage of exact carbon measurement s well as speed, it's surprising it has not yet become the yardstick with which to monitor organics in effluent. The primary reason for its acceptance would seem to be the perceived high cost of initial outlay and preserving the status quo.

Figure 2: PPM on-line TOC system

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Choosing a TOC system

Most TOC systems available today are considerably more advanced than the early systems of the 70's, but there remain differences between systems and no one analyser is suitable for all sample types. Depending on the laboratory or on-line analyzer requirements, receiving advice and guidance here can be important for an effective selection. It is important to realize that only 2 methodologies are approved by the EU and ISO International standards. These are the High Temperature Combustion technique and the UV assisted Persulphate method. Each has its merits, HTC being able to oxidize large particulates and the UVP method is much easier to use. Besides this choice of technique is also the choice of an on-line unit or a laboratory based system. The approach should always be to aim at automated on-line unless the number of sampling points does not warrant the equivalent number of systems for each. For an on-line system to work continuously, the choice is most certainly the UV/Persulphate technology. Although having limited oxidation of large particulates, it would not be as maintenance intensive as on-line combustion systems. The current thinking is to accommodate the particulate contribution with an effective 100um filter in favour of having the system able to work continuously with minimum downtime. Choice of a system that complies with an approved methodology (such as ISO 8245 or AOAC 973.47) is critical to assist the user if disputes arise. The next step would be to calculate the TOC-COD correlation for the effluent samples to set TOC limits corresponding to the municipal COD limits (normally 5000ppm). Assistance in achieving this is available, as local and European companies have done this effectively. In conjunction with TOC, other on-line monitoring, such as pH and conductivity, would be recommended for a complete monitoring picture. This becomes a powerful tool to manage effluents, question the tariffs and be prepared for when TOC is finally accepted. With more industries choosing this alternative, it is no doubt that this would pressurise our local governments to also state, "TOC is also valid" as the German authorities did.

Finally, the question may still be: Why the need for the investment, if things are fine the way they are? Simply, ask existing TOC users, who, all, state that they would not know what to do without their TOC, because it is an indispensable aid in effluent control! Surprisingly, this is often said by lab TOC users, not yet experienced with the additional merits of on-line TOC!

Contact us at LabHouse to discuss how we can help you! 011 465 4405 or info@labhouse.co.za

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