"Out with old, and in with new" – Modern HCRW Incineration under NEM: AQA

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ABSTRACT
The much anticipated remaining provisions of the National Environmental Management: Air Quality Act 39 of 2004 ("NEMAQA") came into effect on 1 April 2010 in terms of Government Notice No. 220 of 26 March 2010. In terms of section 21 of NEMAQA under listed activities, Category 8 included Health Care Risk Waste (HCRW) incineration. The above legislation was a welcome evolution in respect of air quality control, for incineration of HCRW, especially with the poor perception of incinerators as being the least desirable technology to treat and dispose of medical waste. Whilst these revised air emission standards were intended to clean up the industry and remove the stigma attached to incinerators, it was expected and found that the transition from the old Air Pollution Prevention Act (APPA) regulations to the new NEMAQA, would come with its challenges. With the implementation of new legislation, the applicability, practicality and interpretation were found to be some of the challenges experienced by the HCRW management industry.
Enviroserv Ltd. a leading waste management company in Africa has a licensed modern HCRW incineration facility in Roodepoort. The facility has a valid Air Emission Licence (AEL) which stipulates the minimum emission standards applicable to "new" facilities as per NEMAQA. The operations have been running for a few years now under the new license requirements. Compliance and reporting under NEMAQA has proven to be one of the main challenges experienced by the facility. In addition the practicality and interpretation of the new legislation and its requirements has added further complexity and costs to the operations.

With more stringent emission standards, come more costs of compliance. The frequency, number of reports requiring external consultants, and emission monitoring equipment required to meet these standards adds a significant cost to the incineration of medical waste. This results in incineration facilities finding it very difficult to compete with non burn technologies in terms of operational costs. In addition, the shortage of accredited analytical laboratories and suppliers of suitable emission monitoring equipment available in the country as well as expertise within the field further adds to the cost and complexity of compliance. At the Roodepoort facility it was found very challenging to comply with the required emission limit for acid gases using locally available lime for treatment. Trials of various alternative products and studies of overseas markets were conducted to identify more application specific qualities of lime to effectively treat and optimally neutralise the acid gases to meet the new stringent standards. The back end gas cleaning systems of the new technologies now required to meet the regulated emission limits come with their own challenges. Ceramic filters for particulate removal from the gas stream are for example not locally available and have to be imported at high costs; their lifespan has proven to be much shorter than expected resulting in increased frequency of replacement.
Therefore the "chartering of new terrority" when it comes to the implementation of NEMAQA, certainly comes with new challenges which are further expounded in this publication.

Keywords: waste, hazardous waste, disposal, legislation, authorities, HCRW, incineration, cost of compliance, air emission,

1. INTRODUCTION

After much anticipation, the National Environmental Management: Air Quality Act 39 of 2004 ("NEMAQA") finally came into effect on 1 April 2010 in terms of Government Notice No. 220 of 26 March 2010. Incineration of HCRW (Health Care Risk Waste) was included as a listed activity in Category 8 under section 21 of NEMAQA. In terms of air quality control, this was a welcome evolution since it would help clear up the

perception that incineration was not a clean desirable option to treat HCRW. This new legislation has proved to be very stringent in terms of air quality control with extremely tight limits in order to comply. Monitoring and measurement of the air quality was certainly taken up a notch when compared to previous APPA legislation requirements. Although this new legislation will undoubtedly clean up the industry and remove any poor perceptions of incineration, it certainly has proven that the transition from the old Air Pollution Prevention Act (APPA) to the new NEMAQA regulations has come with its own challenges. Some of these challenges included the applicability, interpretation and practicality of the legislation.
Enviroserv Ltd. a leading waste management company in Africa has a licensed modern HCRW incineration facility in Roodepoort. The facility is in possession of a valid Waste Management Licence (WML) for the storage and treatment of HCRW. The facility also has a valid Air Emission Licence (AEL) which stipulates the minimum emission standards applicable to “new” facilities as per NEMAQA. The plant was commissioned in 2011 and operations have been running for a few years now under the new license requirements. Compliance and reporting under NEMAQA has proven to be one of the main challenges experienced by the facility. In addition the practicality and interpretation of the new legislation and its requirements has added further complexity and costs to the operations.

2. COST OF COMPLIANCE

In order to comply with the new stringent emission standards, incinerators had to absorb a huge increase in costs of operations. The frequency, number of reports requiring external consultants, and emission monitoring equipment required to meet these standards adds a significant cost to the incineration of medical waste.

The use of external consultants for auditing purposes, monitoring and measurements of emissions and compliance with the Air Emission Licence is one of the significant contributors to the increased costs. The frequency and number of reports required on an annual basis has increased in the new standards resulting in additional costs and staffing requirements.

Continuous emission monitoring is required as part of the new NEMAQA requirements. This meant that incineration facilities were required to invest in continuous emission monitoring equipment capable of online measurement of pollutants specified as per the legislation. Unfortunately much of this equipment is not available locally in South Africa and had to be imported. It was found that even sample lines were imported. In addition to this, speciality gases required for calibration of the equipment to measure pollutants such as HCl and HF are also being imported. This is due to the fact that few industries use these gases and hence it does not make commercial sense to manufacture these locally. With a weakening currency in South Africa over the past few years, this further added to the cost of compliance when bringing in the requisite equipment, materials and standards from overseas.

Importing of the equipment was the first hurdle to be overcome, which lead to the next challenge of whom has the expertise to implement, maintain and to competently report on data using these monitors once we imported them? The answers to these questions lead to most incineration facilities outsourcing these services to external service providers due to the lack of availability of in-house expertise. It was found that there weren’t too many local companies that could provide the expertise and initial research surveys revealed that only 2-3 companies could supply the monitoring equipment and provide the competent expertise to maintain and report data from the equipment. All of these factors added additional costs to operations in terms of outsourcing services in order to meet compliance requirements. However, the one important benefit of outsourcing this service meant that the data provided from these service providers was accepted as being credible and unbiased. From a compliance point of view, this is seen as crucial as credible and unbiased data could be submitted to the competent authorities. This would further support the initiative of cleaning up the incineration industry and removing the stigma of air quality associated with it.

Dioxins, formed during incineration, are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer. Therefore the testing for these compounds are included as part of the Air Emission Licence requirements. The challenge

that is associated with monitoring this pollutant is that currently there are no accredited laboratories available in South Africa to analyze for this species. Locally available companies that are used to conduct the monitoring typically collect samples which are then sent to overseas laboratories for analysis. The costs associated with monitoring and measurement of dioxins and furans (PCDFs are derivatives of dibenzofuran) therefore becomes an expensive exercise. The competency levels of the companies conducting the sampling campaigns are a further challenge as sampling and testing of incinerators is a specialised field.

3. IMPACT OF GAS SCRUBBING SYSTEMS

The new stringent Air Quality Emission Standards meant that incinerators had to include a back end system for gas cleaning in their designs. HCRW Incinerators are equipped with either wet or dry scrubbing systems to remove acidic emission gases as well as either ceramic filters or bag house filter systems for removing particulates. At the Roodepoort facility, a ceramic filters system was utilized. Ceramic filters used for particulate removal from the gas stream are not locally available and have to be imported at high costs while their lifespan has proven to be much shorter than expected resulting in increased frequency of replacement.
Lime is required for the removal of the acid gases present in the flue gas being emitted from the incineration process. It was found to be a challenge to meet the stringent emission standards using locally available lime and therefore trials of alternative products and studies of overseas markets were conducted to identify more application specific qualities of lime required to effectively treat and optimally neutralise the acid gases. A high performance reagent which had engineered pore architecture for increased reactivity and surface coating for activation of reaction sites was indentified. This enhanced sorbent is used by numerous incinerators in the UK for the treatment of acid gases and has proven to be highly effective. The product was imported and trials were conducted to assess the effectiveness and efficiency of the product versus the locally available products. Key performance indicators were identified at the outset of the trials and measured during the trials with the imported product proving to be a huge success in terms of the efficiency and effectiveness of treatment. The amount of product used to achieve the stringent new emission standards, as well as the reduction in spent lime being captured as a waste on the ceramic filter system was substantially reduced. Other benefits included a faster reaction time when changes were made to the incineration process which could then cater for spikes in the acidic gas content in the flue gas. A product that can offer these results however comes at a price; almost double the cost of the locally available lime adding substantially to the operational cost of the facility . However with the benefits of this product outweighing the shortfalls including the cost reductions in generation & disposal of waste residue lime, it still made economic sense to change over to this product. Further trials were conducted at other incineration facilities and the imported product is now becoming the preferred choice of the HCRW incineration industry.

4. PRACTICALITY OF EMMISSION STANDARDS

One of the pollutants that is required to be monitored on a frequent and in some case continuous basis is Hydrogen Fluoride (HF) as per the new emission standards. Since the Roodepoort operations commenced in 2011, HF has been monitored on a regular basis. The results from external Isokinetic sampling reveal this to be very low to well below detectable limits in most cases. Measurements were also conducted during the commissioning phase of the incinerator for extended periods, and the results were consistently low. However the requirements of the Air Emission Licences being issued to HCRW Incineration Facilities require that this pollutant be monitored and measured on a frequency basis ranging from continuously online to quarterly Isokinetic sampling. Both of these options of monitoring are not cheap and with continuous monitoring significant capex expenditure will be required to import an online monitor. Therefore the question is raised, as to why this pollutant needs to be monitored so frequently considering that past results have indicated very low concentrations to be present in the flue gas of medical waste incineration processes?

Air pollutant concentrations, as measured or as calculated by air pollution dispersion modelling, must often be converted or corrected to be expressed as required by various governmental agencies. Such regulations involve a number of different expressions of concentration. Some express the concentrations as ppmv (parts per million by volume); some express the concentrations as mg/m^3 (milligrams per cubic meter); while others

require adjusting or correcting the concentrations to reference conditions of moisture content, oxygen content or carbon dioxide content. The NEMAQA standards for HCRW incinerators use oxygen content as the reference condition. A reference of 10% O_2 is used in calculations for oxygen correction. This seems quite simple to implement, however in an incineration processes the relationship between oxygen and carbon monoxide is a tricky one to manage and comply with. It is noticed that during the loading cycles of a typical fixed grate incinerator, the Carbon Monoxide (CO) spikes (ie. increases) and oxygen depletes. Therefore "excess air" is introduced into the process to ensure that there is enough oxygen to completely react with the fuel and waste and reduce the formation of CO, which is a toxic gas associated with incomplete combustion. The management of this balance between oxygen and carbon monoxide in the incineration process has proven to be very challenging. The challenges are further complicated by the fact that HCRW incinerators in South Africa are typically small incinerators when compared to similar facilities the USA and Europe, and normally operate at less than 1 ton/hour of waste. The incinerators operational in the USA and Europe are much larger units and run at higher throughputs (typically 3tons/hr or more), therefore it becomes easier to manage this relationship between oxygen and carbon monoxide and control the spikes in CO during loading cycles. Which leads to the question of, "Is the O_2 reference of 10% realistic and practical for the HCRW incinerators currently operational in South Africa"?

5. CONCLUSIONS

Whilst the implementation of NEMAQA was a welcome revision to the emission standards since it will certainly clean up the industry and remove the poor perception of incineration as a clean technology, it has however come at a price. The increased cost of operations in operating an incinerator under these revised emission standards has resulted in incineration becoming an expensive treatment option. As a result incineration operations find it very difficult to compete in the health care risk waste treatment market against non burn technologies. The saving grace so far has been that anatomical waste is still required to be treated by incinerators, thus keeping the technology alive. The chartering of new territory with regards to revised emission standards has certainly proven over the past few years to a very challenging road, and will continue to be an expensive treatment option going into the future.

6. REFERENCES

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National Environmental Management Air Quality Act (39 of 2004)

[i] PCDD -Polychlorinated dibenzodioxins - simply dioxins. PCDDs are derivatives of dibenzo-p-dioxin

PCDF - Polychlorinated dibenzofurans - or furans. PCDFs are derivatives of dibenzofuran