

GUIDELINES FOR THE DESIGN, INSTALLATION AND OPERATION OF INCINERATORS

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ABSTRACT

Incineration of hazardous and medical (clinical) waste creates an air pollution problem which is at the moment controlled in terms of the Atmospheric Pollution Prevention Act of 1965. It is exercised by officials from local authorities in accordance with part 3 of the Act and is very specialized. Consequently, officials from local authorities are not always trained to do this, especially at the smaller municipalities. Therefore, this function is dealt with in the wrong manner, or not dealt with at all.

Incinerators are to be classified into three categories, namely incinerators where the refuse that is being burnt is also used as fuel or as supplementary fuel, incinerators which burn medical and hazardous waste and incinerators which are not used for medical and hazardous waste destruction.

If halogens like chlorine are present in the waste, then there is a definite possibility that dioxins and furans will be emitted during the incineration process. With a halogen content of more than 1% in the waste a minimum temperature of 1100°C for 2 seconds at the inner wall of the secondary chamber is imperative. For cytotoxic waste the temperature must be at least 1000°C. For other waste a secondary chamber temperature of 850°C for 2 seconds is sufficient.

A total particulate emission of 180mg/m³ is recommended in these guidelines as well as emission concentrations for metals like chromium, copper, etc. The emission standard for dioxins and furans has yet to be finalized.

The operation of classes 1 and 2 incinerators is to be controlled by the Department of Health as a scheduled process, except when it is delegated to a local authority with suitably trained officials. Class 3 incinerator operations are to be controlled by local authorities.

These guidelines should minimise the air pollution from incinerators if applied in the correct manner.

1. INTRODUCTION

Air pollution from the use of incinerators is controlled in terms of the Atmospheric Pollution Prevention Act of 1965. The standard applied at the moment is that emissions must be below 40% darkening of the air - shade 2 of the Ringelman Chart (Smoke Control Regulations promulgated in terms of Article 18(5) of the Act for most local authorities, some local authorities use regulations promulgated by the Administrator in terms of Section 101 of the Local Government Ordinance, 1939) for industrial areas or below 21% darkening of the air (up to 20% is permissible) - shade 1 on the Ringelman Chart for areas other than industrial areas, for example residential, commercial, business areas, etc. (Smoke Control Zone

Orders made by local authorities in terms of Section 20 of the Act). If the process conducted on a premises constitutes a scheduled process as described in the second schedule of the Act, then an incinerator on the same premises will be controlled by officials from the Department of Health. If this is not the case, control is exercised by officials from local authorities.

2. PROBLEMS ASSOCIATED WITH CONTROL OF INCINERATORS BY LOCAL AUTHORITIES

Control of air pollution from incinerators is very specialized and officials from local authorities are not always trained to do this, especially at certain of the smaller Municipalities. Consequently, this function may be dealt with in the wrong manner, or not dealt with at all, leading to level 1 control. This means that only Sections 15, 16, 17 and 23 of the Act are applied. Emission standards of 40% or 20% darkening of the air (mentioned earlier) are not applied. Only with level 2 of control, (Section 18 of the Act), 40% darkening of the air comes into effect. Ultimate control or level 3, implies 20% darkening of the air (Section 20, 21, 22, 23, 24 and 25 of the Act)(1).

3. POLLUTION FROM INCINERATORS

Guidelines for this type of pollution are long overdue. Even local authorities exercising level 3 control, did not always have the right answer to this problem. Parameters applied were the following:

1. Multiple chamber incinerators (at least two chambers).
2. Primary and secondary burners.
3. Fly-ash trap (screen).
4. Chimney not high enough (6 metres above a flat roof and 3 metres above a roof with an apex).
5. Retention time in secondary chamber at least 2 seconds.

These were not enough, especially for the incineration of toxic and medical waste, therefore, new guidelines were subsequently developed.

4. DEFINITIONS

Incineration is the process of thermal destruction of any combustible refuse whereby an incinerator is a fuel burning appliance that is used to dispose of any material by means of combustion. (Refer to definition 1(xii) in Act.)

Hazardous refuse is material that can generate noxious or offensive gases when incinerated. This includes toxic and

chemical refuse that may cause a threat to man and his environment.

Medical (clinical) refuse is generated during the diagnoses, treatment or immunisation of humans or animals, any research in connection with this or in the manufacturing or testing of biological agents which include blood, blood products, blood contaminated products, cultures, pathological wastes, sharps, human and animal wastes, isolation wastes, pathogens, cytotoxic materials, hazardous chemicals, toxic metals and low grade radioactive materials.

5. CLASSIFICATION OF INCINERATORS

It was decided to set up a committee to deal with the guidelines in the latter half of 1993. The committee concluded its work in August of this year. The committee decided to classify incinerators into three categories, namely:-

Class 1

Incinerators which use refuse that is being burnt as the fuel or supplementary fuel (e.g. the use of cement kilns for the disposal of noxious or hazardous materials).

Class 2

A : Incinerators in which the waste that is being burnt contain hazardous waste;

B : Incinerators in which the waste that is being burnt contains medical waste.

Class 3

Incinerators in which the waste that is being burnt contains no toxic, hazardous or medical waste. It is suitable for waste from office buildings, flats and restaurants and are designed to incinerate refuse at a rate of 100 kg/hour.

6. MINIMUM DESIGN CRITERIA FOR INCINERATORS

Class 1

The "best practicable means" principle will be applied to incinerators in this class by the Chief Air Pollution Control Officer. This means taking into account the particular industrial process, combustion techniques and emissions.

Class 2

Mechanical feed must be applied here which does not interfere negatively with air supply and temperature in the primary and secondary chambers. Apart from mechanical feeds, feeding must also be hygienic, controlled or automatic.

Refuse may not be fed into the incinerator before the minimum incineration temperature has been attained and the temperature must also be maintained.

The primary incineration chamber must be equipped with a primary burner burning gas or a liquid fuel with a low sulphur content. Primary air supply must be controlled efficiently.

The secondary incineration chamber must also be equipped with a burner burning gas or a liquid fuel with a low sulphur content. Again, the (secondary) air supply must be controlled efficiently.

Flame contact must be effected with the gases. Retention time must be at least two seconds in this secondary chamber. If any halogen-containing substances like chlorine compounds are incinerated, then the temperature at the inner wall of this chamber must be at least 1100°C. If the halogenated organic compound content of the waste is less than 1%, the temperature here can be brought down to 850°C. No cytotoxic materials should be combusted at an afterburner temperature of less than 1000°C. The oxygen content of the exhaust gases may not be less than 7%. Both primary and secondary temperatures must be maintained until all the waste has been completely incinerated. If the incinerator has been designed to operated at a temperature of 850°C in the secondary chamber and if there could be halogens in the refuse, then tests may be required to establish whether dioxins and furans are emitted in the exhaust gases. Periodic tests on the incinerator may be required even if ordinary waste is incinerated.

The chimney's height must be at least 9 metres above ground level and 6 metres above the highest point of the roof. Topography and surrounding buildings must be taken into account with the siting of the chimney as well as the visibility of it from where the operator is standing at the loading platform. The minimum gas emission velocity is to be 15 metres per second.

The temperature of emission gases must be reduced to less than 230°C to prevent the forming of dioxins and furans.

The introduction of dilution air after the combustion zone to achieve the emission requirements should not be permitted.

The total particular emission may not exceed 180 mg/m³ at 7% oxygen and no moisture. Darkening of the air by emission gases may not exceed 10%. The Chief Officer Air Pollution Control may require the measurement of chimney and/or ground level concentrations of the following elements:

Emission concentration limit of 0,05 mg/m ³	
Cadmium and compounds as	Cd
Mercury	Hg
Thallium	Tl

Emission concentration limit of 0,5 mg/m ³	
Chrome	Cr
Berillium	Be
Arsenic	As
Antimony	Sb
Barium	Ba
Lead	Pb
Silver	Ag
Cobalt	Co
Copper	Cu
Manganese	Mn

Tin	Sn
Vanadium	V
Nickel	Ni

Chloride as HCl < 10 mg/m³
 Hydrofluoric acid HF < 2mg/m³
 Sulphur dioxide SO₂ < 25mg/m³

The average dioxin and furan concentrations in the emission gases have yet to be finalised.

Poly-nuclear hydrocarbon compounds, benzene and any other compound which the Chief Air Pollution Control Officer may deem necessary have to be analysed.

The Chief Air Pollution Control Officer may require the following instruments namely:

- Temperature measurement at the inner wall of and the exhaust of both the primary and secondary incineration chambers as well as smoke density, gas flow;
- and a particulate meter and any other meter required by the Chief Officer.

The siting of the incinerator is important and it is only permissible in an approved zoning of the Town Planning Scheme as incineration can be classified as a noxious industry.

The origin and nature of materials to be incinerated, must be known and incinerated in an incinerator suitable for the type of refuse. A record must be kept of the volume, mass and nature and origin of the refuse to be incinerated. Incineration may only take place when the temperature inside the incinerator is high enough. The incinerator must always be kept in a good working order and no incineration may take place when any part of it does not work properly. A complete manual must be available to the user of this appliance. The operator must be suitably trained and the appliance and the environment must always be kept clean. If noxious or offensive gases are emitted which have not been destructed by incineration then further control measures would be required like scrubbers, bag filters or electro-static precipitators. The disposal of ash and liquid effluents are important and should be in accordance with the accepted norms.

Class 3

In this case it is not imperative to use a mechanical feeding device. Usually the incinerator must be fitted with the primary burner in the primary incinerator. A secondary burner must be present at all times and must be able to burn at a temperature of at least 850°C. The gas retention time must

be at least two seconds in the secondary chamber. Chimney height, siting and general requirements with the exemption of record keeping of the volume and nature of the refuse are applicable here as required for class 2 incinerators.

7. LEGAL CONTROL

Classes 1 and 2 will be scheduled processes and the Chief Officer will be responsible for control over these incinerators. The definition of Chemical Incineration Process (Scheduled Process No. 39) must be amended as follows:

- 39 "Waste Incineration Processes. Process for the destruction by incineration of waste that contains chemically bonded halogens, nitrogen, phosphorus, sulphur, metal or any waste which can produce noxious or offensive gases." The Chief Officer can delegate the function of inspection and legal control of this to a local authority appointed person in respect of Article 6 (5) of the Act.

Class 3 control will be done by the local authority by right of Part III of the Act.

8. TYPES OF INCINERATORS AND TEMPERATURES BY WHICH THEY BURN IN JOHANNESBURG

Class 1 - 0.

Class 2 - 11 incinerators - operating temperatures 800°C to 900°C.

Class 3 - 94 incinerators - operating temperatures 600°C to 800°C.

Only one incinerator falls under Class 1 incinerators, that is at Pretoria Portland Cement (PCC) factory in Germiston.

As evident for Classes 2 and 3, the operating temperature is not sufficient and attention should be given to the increase of this temperature.

9. CONCLUSION

Control over the air pollution from incinerators at the moment is not sufficient.

Guidelines for the operation of incinerators from an air pollution point of view, fill, therefore, an important gap in our present legislation.

REFERENCES

- 1 Air Pollution in South Africa, printed by the Department of Health, 3rd Edition, November 1993.