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Impact of Particulate Matter Emission Reduction with Respect to Sizing of Sponge Iron Kiln

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AIM: To study impact of particulate matter emission reduction with respect to sponge iron kiln size.

Keywords: Sponge Iron Kiln, Direct Reduction Process, Emission Estimation Technique, Particulate Matter Emission, Pollution Control Equipment.

I. PRINCIPLE

For estimation of Particulate Matter emissions from sponge iron kiln most important factor is selection of estimation technique. Basically, direct measurement for characterising emissions is most accurate method and it should be used in preference to other Emission Estimation Techniques. Emission factors are normally prepared through testing of a source like various burning chambers of a particular fuel type. The basic assumption for using an emission factor is that all components of the source can perform in the same manner with minimum variation.

Quantity of a pollutant emitted to activity rate or throughput is given by:

Emission Rate (mass per time) = Emission Factor (mass per unit of throughput) X Activity Rate (throughput per time)

Similarly by Mass Balance Techniques the quantification of total materials into and out of a system or process, with the difference between inputs and outputs can be measured in terms of mass releases to the environment, as an emission or as a transfer. Mass balance is particularly useful for the estimation when the input and output streams are quantified. This is most important for individual process units and operations.

The mass balance calculation can be given by:

Total mass into process = Total mass out of process

Or, Inputs = Products + Transfers + Emissions

where:

Inputs: All incoming material used in the process.

Emissions: Releases to air, water and land.

Transfers: transfers include substances discharged, substances deposited and substances removed from a system for destruction, treatment, recycling, reprocessing, recovery or purification.

Products: Products and materials emitted from the system.

Or, $E_i = \Sigma Q_a W_{a,i} \rho_a - \Sigma Q_o W_{o,i} \rho_o$

where:

E_i= emission rate of component i (kg/hr)

Q_a= volumetric flow rate of inlet stream a (scm/hr)

Q_o= volumetric flow rate of outlet stream o (scm/hr)

$W_{a,i}$ = weight fraction of component i in inlet stream a

$W_{o,i}$ = weight fraction of component i in outlet stream o

ρ_a, ρ_o= density of streams a and o respectively (kg/scm)

II. METHODOLOGY

For the study, Emission factors technique is considered for calculation of particulate matter emission from stack. Any operating industry having ESP which has been designed to achieve Particulate Matter [PM] emission level below 50 mg/ Nm3 by upgradation of its ESP to achieve Particulate matter emission level below 30 mg/ Nm3, then certainly it will have positive impact on environment.

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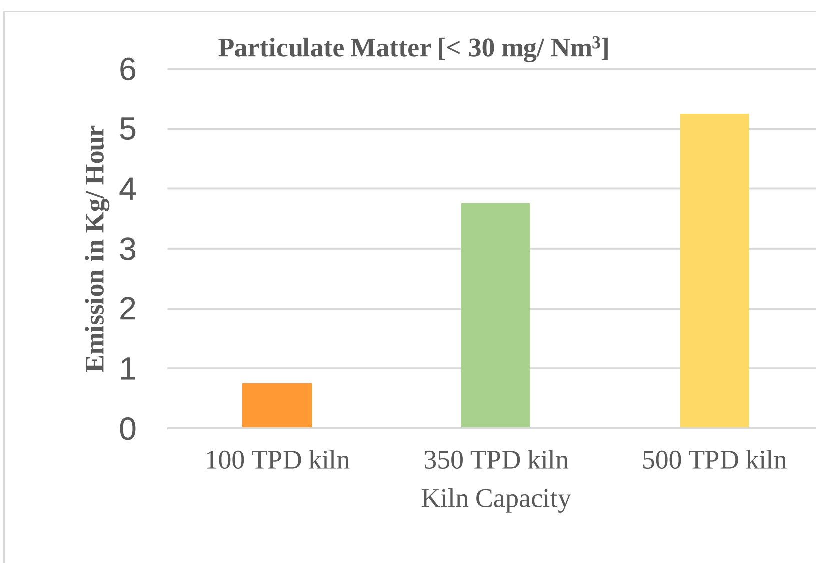
For calculation purpose we have taken standard condition for 100 TPD Sponge Iron kiln, 350 TPD Kiln and 500 TPD Kiln. Volumetric flow as earlier given will remains same i.e. for 100 TPD Kiln it will be 25000 Nm3/ Hour, for 350 TPD Kiln it will be 125000 Nm3/ Hour and for 500 TPD Kiln it will be 175000 Nm3/ Hour.
Following is the parameter details of installed sponge iron plants :

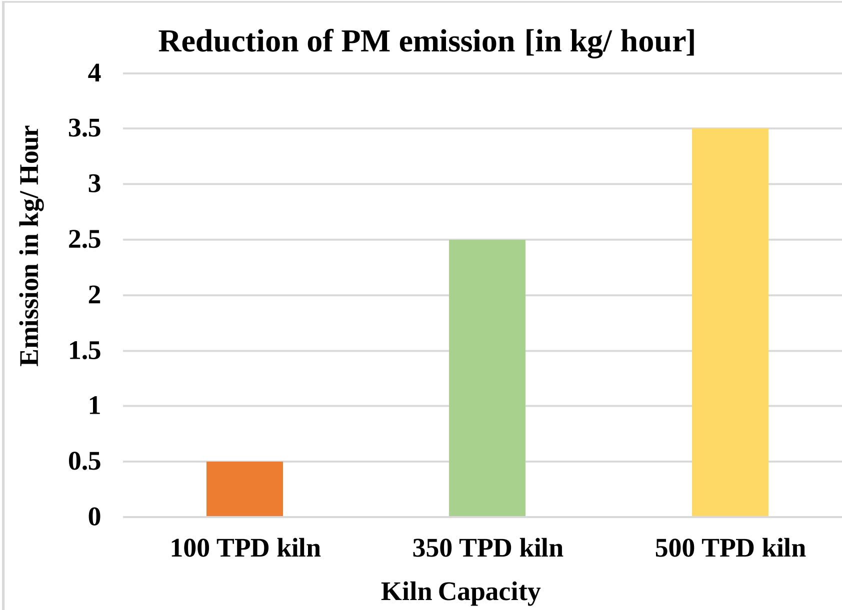
Description	Parameters		
	100 TPD kiln	350 TPD kiln	500 TPD kiln
Effective Diameter of Kiln (ID), m	2.6 m	3.9 m	4.4 m
Length of Kiln, m	45 m	76 m	80 m
Support, No.	2 station	4 station	4 station
Kiln speed, rpm	0.42	0.42	0.42
Diameter of cooler (ID), m	2.3 m	3.2 m	3.6 m
Length of cooler, m	26 m	45 m	50 m
Support, No.	2 station	2 station	2 station
Slope %	2.5	2.5	2.5
Cooler speed, RPM	0.98	0.98	0.98
Production per Kiln, tpd	100	350	500
Generation of DRI fines (-3 mm), %	35 to 37	42 to 45	42 to 45
Shifts per day, No.	3	3	3
Coal Input [tpd]	83	287	405
Iron Ore Input [tpd]	145	145	145
Dolomite Input [tpd]	2.8	8.8	14
Water Consumption [m3/ day]	75	150	225
Inlet dust concentration at ESP [g/ sec]	75-100gms	100-125gms	125-150gms

III. RESULT

Below tables stipulates the scenario of existing norms and proposed norms for different capacity sponge iron plants. If industry follows the stringent Particulate Matter emission norms i.e. below 30 mg/ Nm3 the reduction in Particulate Matter emission that for 100 TPD DRI Kiln, Particulate matter emission will reduce from 1.25 kg/ hour to 0.75 kg/ Hour; for 350 TPD DRI Kiln, PM emission will reduce from 6.25 kg/ hour to 3.75 kg/ Hour and for 500 TPD DRI Kiln, Particulate matter emission will reduce from 8.75 kg/ hour to 5.25 kg/ Hour.



There will be net reduction of 0.5 kg/ Hour, 2.5 kg/ hour and 3.5 kg/ Hour in Particulate Matter emission level for 100 TPD, 350 TPD and 500 TPD DRI kilns respectively.



IV. CONCLUSION

There are several techniques for estimation of emissions from stacks. The technique adopted for this study is based on emission factor which provides real data over other techniques which are based on assumptions and hypothetical modelling.

There is need for revamping the emission norms in siltara and urla industrial area for improvement in air quality of the surrounding. Reduction in emission norms of particulate matter will reduce the overall pollution load in the air which will improve the environment. We do not have large resources to spend on introducing clean technology in the whole industrial sector, however, as the analysis shows significant reduction in air pollution load can be achieved. The study also reveals how reductions in Particulate matter emission norms will more effective in larger size of kilns.

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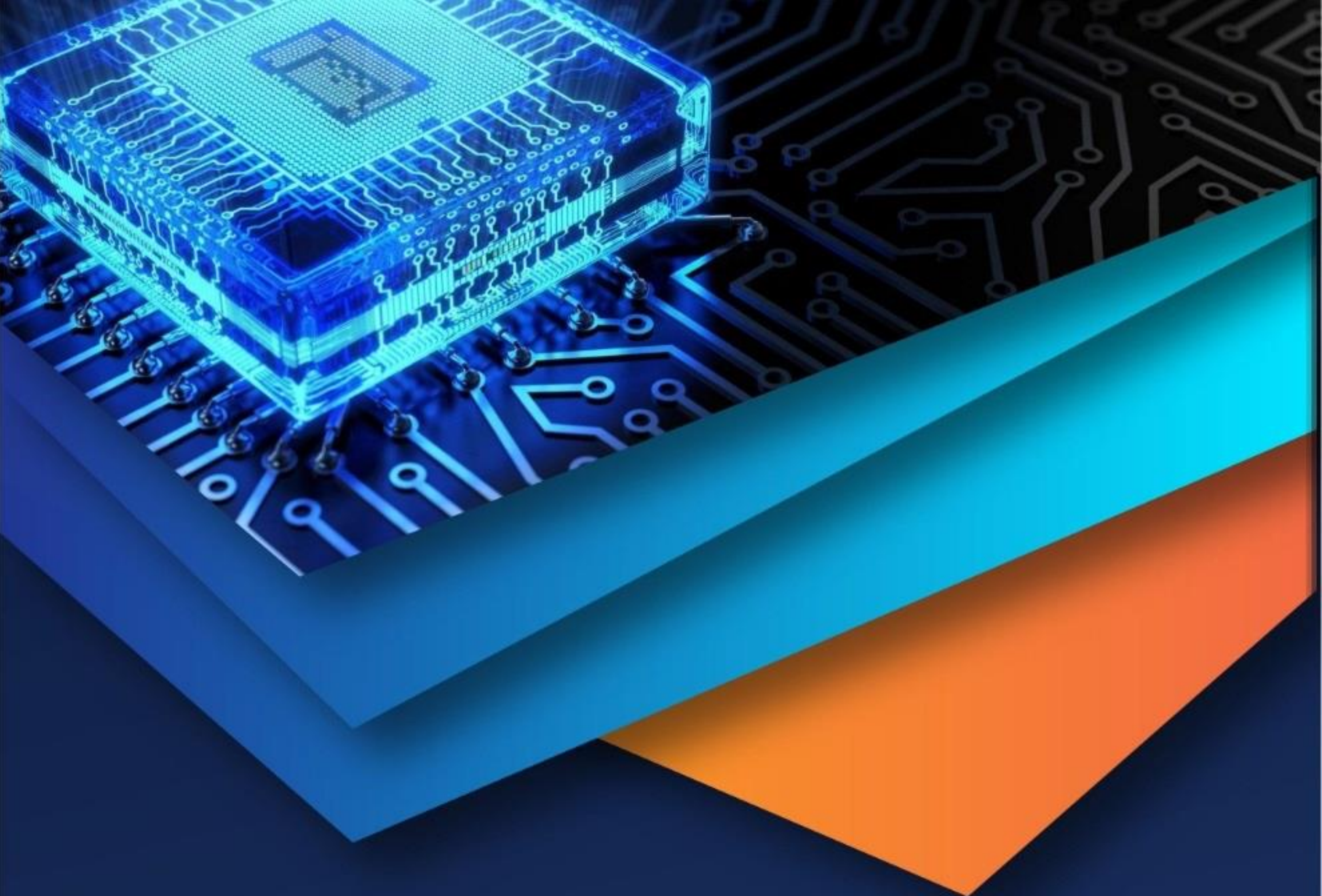

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