Futuristic views of end pipe technologies in foundries

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Abstract: Right from the olden days, many products have been produced using foundry practices. These foundry practices include melting of the metals pouring these molten metal's into the moulds and cleaning the solidified metals. These foundry practices are carried out in foundries which contribute towards the wealth generation of the societies in which they function, while achieving this kind of benefit through the functioning of foundries, it is surprised that the emission released by the foundries affect the health of humans. Hence foundries have been installing end pipe technologies, in line to this development researchers have been examining the efficiencies of these end pipe technologies in controlling emissions from the foundries situated in various parts of the world. In this context a literature survey was carried out, it was found out that, the effectiveness of cassette filter is yet to be examined by the researchers. This is a surprising research and practice gap. Quite interesting, the description of cassette filter is yet to be documented. Hence the salient features of cassette filter in achieving pollution control in foundries are described. The final result of the investigation has indicated that cassette filter incorporated in induction furnace enables to achieve the best efficiency in controlling the pollution through foundries. The paper is concluded by pointing out the need of employing cassette filter in induction furnaces for reducing the emissions from the foundries whose values will be within the levels stipulated by the pollution control organization.
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1 Introduction

Foundry practices are used in contemporary world to produce large volume of components and products(*Wang et al.,2012).* After the middle part of the twentieth century, the world community begun to realize that, foundries were emitting pollutants which were affecting the health of humans. In order to overcome this situation, several countries in the world promulgated laws stipulating the maximum level of pollutants that can emit by foundries. These laws affected the functioning and growth of foundries.

In order to sustain amidst these constraints, foundries begun to adopt end pipe technologies (*Cheng et al.,2008).* In this back ground, this paper reports to assess the contemporary scenario and project the future needs for sustaining the foundries with end pipe technologies. During the conduct of this literature review, it was discernable that, research papers have reported certain drawbacks of existing end pipe technologies .Firstly High power requirement, it is evident that during high pressure drops high collection efficiencies for particles can be attained which would result in high operation cost in cyclone filters and electrostatic precipitators (Rathi*,2003).* Secondly Water-disposal problems, generally waste water regulations can be met by either using settling ponds or sludge clarifiers then also Sludge disposal is very expensive. in wet scrubber (*Krishnaraj et al,. 2012).* Thirdly Difficult product recovery, basically Recovery of any dust by dewatering and drying of sludge makes it expensive and difficult for reuse (Fore and Mbohwa*j 2010).* The analysis of the information and knowledge drawn from drawbacks has revealed that, researches exploring the sustenance of foundries situated in different parts of world are required to be carried out intensively in future. Yet, many foundries are yet to install efficient end pipe technologies.(*Krishnaraj et al.,2012; Mukherjee., 2010*), In this context a literature survey was carried out, it was found out that, the effectiveness of cassette filter is yet to be examined by the researchers. This is a surprising research and practice gap. Quite interesting, the description of cassette filter is yet to be documented. Hence the salient features of cassette filter in achieving pollution control in foundries are described. In this context, the need of carrying out latest end pipe technologies used in foundries is increasingly being realized by the theorists and practitioners. The details of reviewing these researches from the contemporary and futuristic views are presented systematically in the following

sections of this paper.

2. Literature review on the application of end pipe technologies in foundries:

Although foundries have the potential to increase the wealth of the countries in which they are located, many governments are desisting away from encouraging the operation of(Neto et al., 2008) foundries due to the pollution caused by them. On the other hand, some countries have been striving to adopt pollution control strategies for operating the foundries effective latest end pipe technologies while without causing any harm to the humans.The highlights of this exercise are presented in this section Biswas et al., (2001). These authors have studied the functioning of cupola based foundries with regard to their adherence to the pollution control norms that are prevailing in India. Fore and Mbohwa,(2010) These authors have reported a case study in which they have traced the impacts of pollution that are caused during several foundry practices. These authors have mentioned that cyclone, scrubbers, bag houses and electro static precipitators are the major end pipe technologies that can be used to control dust emission in foundry industry. The review of the papers presented in this section has indicated that, their exists high potential for utilizing pollution control devices in foundries to achieve cleaner production in the production of castings. However, the research in this direction has so far been carried out only by few researchers. More researches will enable the cleaner production engineers to develop improved end pipe technologies , that could be utilized for carrying out cleaner production in foundries and thereby, for achieving higher profitability Yu et al., (2006). These authors have also mentioned that, few pollution control devices are used in foundries located in South Korea.Polizzi et al., (2007) have reported a research in which they have studied the impact of aluminum and iron air pollution caused due to the existence of aluminum and iron casting foundries in Turin District of Italy.These authors have conducted this study in a place where motorway networks and vast farmland exist. These authors have carried out this study for three months by taking samples of air from this area. These authors have tabulated the aluminum and iron concentration that they measured using particulate matter size in $\mu g/m^3$. These authorshave presented the mean and standard deviation of these values. The major finding is that, even though, the place of gathering sampleswas located six kilometersfrom the iron and aluminum foundry, the pollutants emitted from these foundries were found to impact on particulate matter of air pollutants. These authors have expressed their inability to appraise the impact of these kinds of pollution on the human health due to the non-availability of the appropriate data. Lin et al., (2011).The research reported by these authors indicates that, the pollutants emitted by the foundries are harmful to the humans, but their emissions can be controlled using pollution control devices. Anderson et al., (2008). These authors have found out that, in majority of the cases, occupational exposure limit (OEL)was not very high. These authors have traced the past data furnished by similar researchers were conducted in the US iron foundries. These authors have found that, during earlier days, the health hazard was found to be significant among the workers of iron foundries..The highlights of the contributions of the papers reviewed in this section have indicated that, the researchers from very few countries have surveyed the pollutants emitted by the foundries and their impact on the health of the operators.This situation implies that, this kind of researches is to be conducted in several other parts of the world where a cluster of foundries exists. Some of those countries in which these clusters of foundries exist are India, Italy, Swedish, and SouthKorea. In different parts of those countries, the researches on applying cleaner production technologies in foundries are required to be conducted intensively. Rabah, (1999) This author has also mentioned that, many foundries in Egypt are not financially capable of preventing pollution by installing pollution control devices and abatement options. Hence, it is required to analyze the utility of these options in foundries from that financial management point of view.

Pal et al., (2008) These authors have pointed out that, till the year 1991, these foundries were running well.From the year 1991, India began to enter into liberalization era. After that, stringent pollution control norms were broughtout by central pollution control board of India. This development made the functioning of foundries in India a challenge. Fatta et al., (2004) These authors have mentioned about the directives of an agency called Integrated Pollution Prevention Control (IPPC). These directives are employed in Cyprus for controlling the emissions of pollutants from the factories. Murkerjee (2010)has also found out that, economic factors prevent the implementation of advanced melting technologies and end pipe technologies in the foundries that have were surveyed during their research. On the whole, the researchers reported in the above papers have indicated that, foundries located in certain parts of the world have been progressing well. These foundries have also been striving to sustain by implementing various end pipe technologies. Though the foundries are located in different parts of the world, the end pipe technologies employed are similar in nature. For example, Antunes et al., (2012) In this paper also, it is mentioned that, cyclone and bag filter are used as the PCDs in the foundries of Portugal. In spite of the progression in the development of PCDs, their application in foundries has just begun and foundries have been looking for the

ways of applying them to get the economical gain. In line to this development of end pipe technologies, Cassette filter system is yet to be documented ,hence a conceptual framework is discussed in the subsequent section.

3. Conceptual framework of a dry scrubber system

As shown in Figure 1, the flue gas material entrained in the Dry Scrubber must pass into the tubes for removal. As the flue gas flows into the two entrance slots of each tube, the tangential velocity imparted develops a centrifugal force action on the gas and entrained particles. Since the entrained material is much heavier than the flue gas, this material is thrown to the cylindrical walls of the lower portion of the tube. By gravitational action the still-rotating solids and/or liquids move down to an opening in the bottom of the conical section of the tube and fall into a storage section beneath the tube section.

The clean flue gas rises through a smaller diameter tube, which is centered to the bottom of hood. Hood having the screw rod mechanism when screw rod is rotated the solid powder particle passes through out of the dry scrubber system.

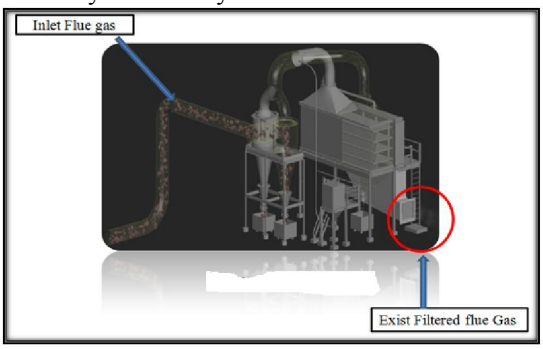

Figure 1. Process flow diagram of Cassette filter.

In any separator, the size particle, which can be separated, depends on the particle density, the gas density, and the magnitude of the centrifugal force, which must be developed to throw the particle out of the gas stream.

3.1 SALIENT FEATURES OF CASSETTE FILTER

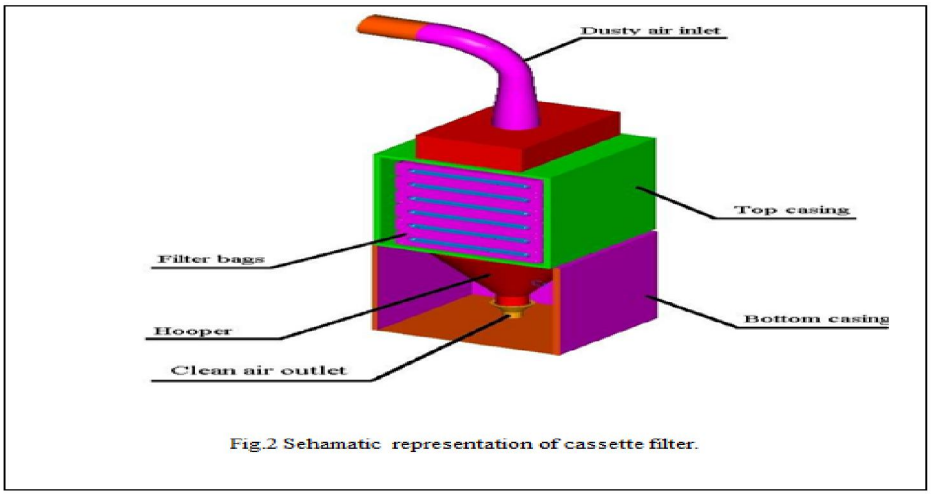

Fig.2 Sehamatic representation of cassette filter.

As shown in Figure2 Cassette type Filter comprises the hood for dust laden gas, the filter casing, the dust collection hopper with the support structure and discharge unit. The filter bags are arranged horizontally in the dirty gas chamber and their connection with the slotted valve by the clamping frame with the leg springs is air tight. The flow direction through the filter is from top to bottom (down flow principle). The gas enters the clean gas chamber of the filter through the flat bag. During this process, the dust is held back by the filter media and forms a filter cake which is important for filtration. The fully programmable deducting process is activated after a specific time period and the dust cleaned out of the filter hose. The dust falls in to the collecting hopper and is conveyed out via dust conveying unit.

3.2 Merits of cassette filter

The present trends in end pipe technologies is cassette filter which saves valuable space, through less foot print and more filter area for the same casing volume when it is used. For convenience, opening of a door at the hopper break line level is provided, which allows easy access to cassettes from clean gas side. Corrosion free long life can be obtained by using galvanized distant mat and there is no damage to fabrics and bag movement. Through which Low average emission rate is achieved. To eliminate the lengthy duct connection to fan, a clean gas outlet is present at the bottom. Cassettes are held on to a vertical sheet to eliminate the possibility of eventual

accumulation of dust and prevents fire hazard caused by explosive dust.

4.Conclusion:

The emission levels are controlled to below 20mg/ nM^3 which meets European standard by usage of cassette filters in the induction furnace. This standard is recommended to industrialist and academician to be followed rather by replacing wet scrubber in induction furnace which has a controlled emission level below 50mg/Nm^3 and this meets the state and Central pollution control board *norms*. The knowledge that would be generated from this research would be useful to bring out solutions for sustaining the foundries located in several clusters by adopting cassette filter. The accomplishment of this goal will result in future the abundant wealth generation through the foundries located in several clusters.

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REFERENCE

[1] Wang,Y., Cannon, F.S., Salama, M., Goudzwaaed, J., Furness, J.C. (2007). Characterization of Hydrocarbon Emissions from Green Sand Foundry Core Binders by Analytical Pyrolysis, Environmental Science andTechnology, 41 , 7922-7927.

[2] Fore, S., Mbohwa, C.T. (2010). Cleaner Production for environmental conscious manufacturing in the foundry industry. Journal of Engineering, Design and Technology, 8, 314-333.

[3] Rathi, A.K.A. (2003).Promotion of cleaner production for industrial pollution abatement in Gujarat(India).*Journal of Cleaner Production,* 11, 583-590.

[4] Lin, M.H., Liou, S.H., Chang, C.W., Huang, I.H., Strickland, P.T., Lai, C.H. (2011). An engineering intervention resulting in improvement in lung function and change in urinary 8-hydroxy deoxyguanos in eamong foundry workers in Taiwan.Int Arch Occup Environ Health, 84, 175-183.

[5] Polizzi, S., Ferrara, M., Bugiani, M., Barbero, D., Baccolo, T. (2007). Aluminium and iron air pollution nearand iron casting and aluminium foundry in Turin district Italy.*Journal of Inorganic Biochemistry,* 101,1339-1343.

[6] Cheng, Y.H., Chao, Y.C., Wu, C.H., Tsai, C.J., Uang, S.N. and Shih, T.S. (2008).Measurements of ultrafine particle concentrations and size distribution in an iron foundry.*Journal of Hazardous Materials,* 158, 124-130.

[7] Neto, B., Kroeze, C., Hordijk, L., Costa, C. (2008). Modeling the environmental impact of an aluminum pressure die casting plant and options for control.Environment modeling and software, 23, 147-168.

[8] Krishnaraj, R., Sakthivel, M., Devadassan, S.R. (2012). Performance Efficiency of Wet scrubber In Induction Furnace Towards Green Revolution-A case study in Indian foundry.*Journal of Environmental Research anDevelopment* ,6,824-833.

[9] Mukherjee, D.P. (2010). Barriers towards cleaner production for optimizing energy use and pollution control for foundry sector in Howrah, India. Clean Techn Environ Policy.

[10] Antunes, P., viana, P., vinhas,T., Rivera, Gaspar,E.M.(2012).Emission profiles of polychlorinated dibenzodioxins, polychlorinated dibenzofurans (PCDD/Fs),dioxin-like PCBs and hexachlorobenzene (HCB)from secondary metallurgy industries in Portugal. Chemosphere, 88, 1332-1339.

[11] Yu B.W., Jin G.Z., Moon Y.H., Kim M.K., Kyoung J.D., Chang Y.S., (2006), Emission of PCDD/Fs and dioxin-like PCBs from metallurgy industries in S.Korea, *Chemosphere,* **62**, 494-501.

[12] Biswas D.K., Asthana S.R., Rau V.G., (2001), Pollution management with techno-economic evaluation for coke based and cokeless cupolas, *Applied Thermal Engineering,* **21**, 359-379.

[13] Rabah, M.A. (1999) Cost effectiveness of abatement options for emissions control in Egyptian iron foundries. *Waste Manage,* 19, 283–292.

[14] Pal, P., Sethi, G., Nath, A., Swami, S. (2008). Towards cleaner technologies in small and micro enterprises: a process-based case study of foundry industry in India.*Journal of Cleaner Production*,16, 1264-1274.

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