Progress of Emission Control System in Electric Arc Furnace Melt-shops

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Electric arc furnaces use iron scrap as a major iron component in the manufacture of steel primarily used in construction industry. In most advanced countries EAFs produce 30–35% of total steel production. The composition of scrap, which is substantially an industrial waste, constantly changes and cannot be accurately defined, as it contains up to 2% of such combustibles as oil, plastics, and paint. Since many meltshops are installed in urban areas where scrap is easily obtained, air pollution contained in off-gas emissions from an EAF melting furnace can sometimes becomes a serious problem. In Japan in the last 20 years, air pollution problems emanating from melt-shops have been resolved by fully enclosing the melt-shops and installing a large capacity secondary emission control system. However tD(/)Hry oP(terokKD(/)Hla(terokKs[Htem. knnnlgdatmosphere may be regulated in the near future. This problem cannot be solved by simply increasing the flow rate capacity of the dedusting system, therefore NKK has been systematically changing the criteria for design and operation through investigation of the relationships between the off-gas emission pattern, in-house gas stream, operational sequence of the dedusting system, and floating dust loading of the workspace atmosphere.

The design concept of a direct evacuation system, which induces process gas to cool down and dedust, has changed dramatically, as the demand for higher

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can be considerable, NKK has investigated and developed measures to reduce these problems.

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. 1 is a conventional dedusting system for a typical EAF melt-shops with a 100 tons EAF. The total dedusting system consists of (i) a direct evacuation system and (ii) a secondary emission control system. The former is used to induce outside air into the high-calorie off-gas from the furnace to assist with combusting the uncombustibles, primary dedusting, and temperature reduction of the hot gases before it is sent to the dedusting equipment. The hot gas temperature is cooled down to approximately 350℃ through a long (100–150 m) water-cooled duct and then mixed into the secondary emission control system via a direct evacuation blower. Gas flow rate is about 2000–2500 m^3_N/min for 100 tons EAF.

The latter one, the secondary emission control system, is used to ventilate the total EAF melt-shops. Gas flow rate is about 20000 m^3_N/min after being mixed with the former hot gas. A main canopy is installed above the furnace in order to collect transient hot gas which is generated during the scrap charge. There are several additional canopies for auxiliary dedusting thus permitting gas temperature at the baghouse to be less than 100℃.

There are cases where the direct evacuation gas is not mixed with the secondary emission control system and a baghouse is installed separately. However, in this case gas temperature at the separated baghouse may sometimes exceed 200℃ and the elimination of dioxin by condensation becomes more difficult. For this reason the confluence type design is becoming the more acceptable standard.

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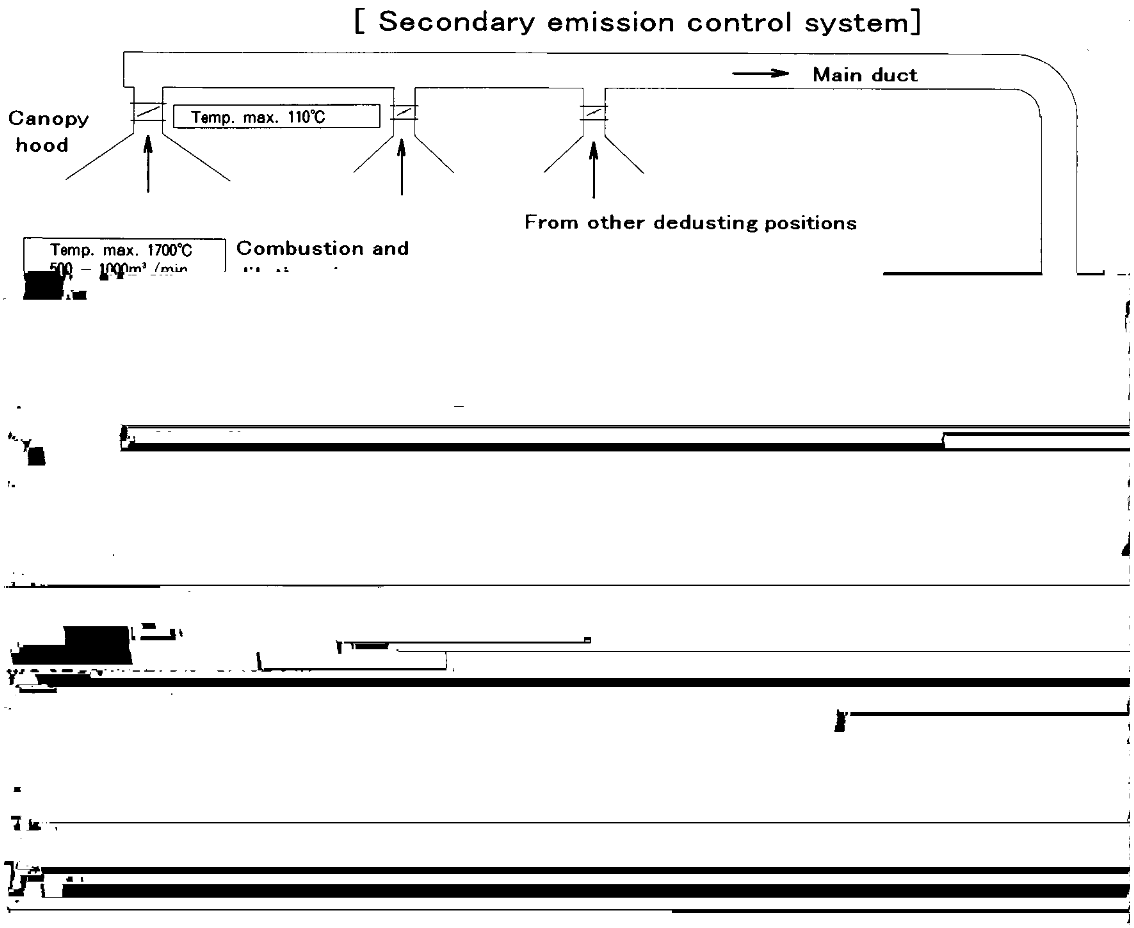
Since it is not easy to define a floating dust load quantitatively, the inheritant capacity capability of the dedusting system has been recognized as the fan and baghouse capacity. This capacity is determined based



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Such heat sources as ladle heater and continuous casting machine exist.

Suction flow rates through canopy hoods change according to the settled pattern.

Measured data are used for hot gas temperature, flow rate, and dust loading which is generated during scrap charge.

Diffusion and settling velocity of dust are calculated based on a supposition that the dust size is smaller than 7.07 μ m.

Calculation outputs are temperature, dust loading, and the gas velocity vector of each cycle time and location defined. **. 3** and **. 4** are examples which show dust loading distribution 480 seconds after the scrap charge. **. 3** is the case for existing equipment where the decrease in dust loading takes a fairly long time. **. 4** is the result of the case study of improvement, where the isolation wall for CC yard is installed, ning the initial design or the improvement of a secondary emission control system.

(1) Since induced air velocity varies inversely proportional to the square of the distance from the source to the canopy hood and a strong ascending stream around the furnace is caused mainly by heat convection, a hood such as that located above a charging crane is not an effective design because of its distance from the source.

the phenomena and the following data was revealed:
(1) As for the acid elements, sulphur dioxide and nitrogen oxides were at a level of several ppm. Hydro-

(2) Though water-cooled ductwork operate efficiently in the high temperature portion, it requires a large heat transfer area when gas temperature becomes less than 500℃. NKK has tried a direct spray cooling system to make the facility compact and has achieved good results.
(3) It is possible to eliminate a very expensive direct evacuation blower and to connect the direct evacuation line to the main header. The direct evacuation blower is expensive for its high temperature use and anti-abrasion construction. Even though the header pressure must be lowered to about –2500 Pa, which is generally –1500 Pa in case this type of blower exists, the increase in operation cost is less than the decrease in initial cost[2). NKK has adopted this system for K-steelmill in Taiwan which resulted in the expected effect.
(4) Water-cooled ducting should be designed to be easily maintained when damaged. Interference with surrounding equipment while exchanging a duct should be avoided.

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With the increasing capacity of dedusting systems in electric arc furnace melt-shops, recent investment cost for dedusting system exceeds the cost for EAF itself. This large scale system, however, cannot show its ability completely without proper basic planning and intelligent operation. Recent requests to NKK for consultation concerning EAF operation and equipment modification are mainly related to dedusting system problems and governmental air quality regulations rather than energy saving or production increase. NKK has supplied dedusting systems to over 30 meltshops and thereby has accumulated a great deal of experience and know-how. Based on this technology we believe we are contributing to environmental improvement inside and outside of meltshops.

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1) “Factories Environment Improvement Handbook”. Shuujin Souchi Corporation.
2) M, Bender. “ Emission control aspects of modern electric furnace”. Bender Corp. tech. document.
3) Yamaguchi, R. et al. “Simulation of EAF Melting”. NKK Giho. No. 163, pp. 35–40(1998).
4) Nakayama, M. “Dynamic Thermal Efficiency Analysis of Electric Arc Furnace”. NKK Giho. No. 167, pp. 1–6(1999).
5) Endo, H. “Research for Corrosion and Anticorrosion of Steel”. Uchida-roukakudou.