METHOD FOR DRAWING OFF CONVERTER GASES

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There also exist systems for separating dust and for completely burning off the converter gases in which the amount of air added to the converter is not regulated. Such systems are built along the same basic lines as systems in which the suction blower and the combustion of the converter gases is regulated. Here, too, the air needed for the combustion is supplied partly or entirely by means of suction blowers, but the suction output of the blower is maintained the same throughout the entire oxygen blowing phase. Inasmuch as in these systems, too, the object is to achieve complete combustion of the converter gases throughout the entire blowing phase, this constant suction output has to be adapted to the conditions prevailing at the instant at which the maximum carbon has to be burned off, which occurs at the time the amount of waste gases issuing from the converter is at a maximum. It is not absolutely necessary that the quantity of gas withdrawn by the suction blower be made exactly equal to the amount of gas issuing from the converter, because if, for example, there is an excess of air, the increase in the volume of the gas causes the dust separator to pick up more steam, as a result of which no further air will be taken in, provided the blower continues to produce a constant suction. In this way, the cooled gas collector hood, which provides the annular curtain of air, can be dispensed with.

Another advantage of the installations which operate with unregulated combustion of the converter gases is that the complicated and expensive regulating systems which control the suction blowers and the differential pressure scrubbers can be eliminated. Also, the elimination of these regulating systems substantially reduces the power consumption of the installations as a whole. However, one major drawback of such unregulated installations, as compared to the regulated installations, resides in the large amounts of waste gases which are produced and which, if a waste boiler of the same size is to be heated, makes it necessary to provide a relatively very large dust separator. This, in turn, increases the initial costs of the installation as well as its operating expense, and at the same time decreases the amount of steam which can be generated.

There also exist systems in which the drawing off of the converter gases is regulated but in which the gases are not combusted prior to being subjected to the action of a dust separator. Such installations are used in steel mills in which there is little or no need for the steam which might be generated by the combustion of the converter gases. In such installations, the most important thing is that the dust be separated from the converter gases, and the utilization of the heat which might be available from the converter gases is but an incidental feature. In such installations, the converter gases are drawn off by means of a cooled, open gas collector hood which is provided with means for producing an annular curtain of air so as to prevent air from infiltrating, the drawing off of the converter gases being regulated. This is done by the suction of the gas collector hood, or, more accurately, that of the suction blower, as well as the dust separation of the differential pressure scrubber to the amount of gas developed in the converter during the blowing phase, this being effected by means of a regulating arrangement. After the converter gases have been cooled and after the dust has been separated out, the clean gas, consisting mainly of carbon monoxide, is either burned off in a flame, or is bottled for future use. One advantage of such an arrangement is that the installation as a whole is relatively inexpensive, this being due to the relative small amounts of waste gases. Another advantage is the fact that the final cleaning of the converter gases can be readily adapted to the amount of waste gases by means of the differential pressure scrubber; this is important because the amount of waste gas fluctuates considerably during the blowing
phase. Still a further advantage is the relative low energy consumption, as well as the fact that the system is very reliable, thanks to the use of the gas collector hood which provides a suitable air curtain. The major drawback of such an arrangement, on the other hand, resides in the fact the differential pressure scrubber and the suction blower have to be equipped with the usual expensive regulating systems.

It is, therefore, the primary object of the present invention to provide a method of the above type which overcomes the disadvantages of the known systems and which combines their advantages. That is to say, the major object of the present invention is to provide a method which involves a structurally simple system, free of any regulating means, and which is therefore, capable of being built at low initial cost.

According to the present invention, these objects are achieved by providing a system in which the differential pressure scrubber which serves as the dust separator operates unregulated during the time the iron is being blown, and in which the dust-laden air, which leaves the converter gases produces a constant suction. Undesired air is prevented from penetrating into the system in the region of the mouth of the converter by an open, cooled gas collector hood which is provided with means for producing an annular curtain of air.

The process according to the present invention may be described by way of examples as follows:

**Example 1**

Waste gases in the amount of 8 m.³ NTP per minute per ton of pig iron are blown into a converter if a minimum amount of air enters the mouth of the converter and if the carbon content of the pig iron is burnt with a maximum combustion rate of 0.4% per minute. The suction blower operates at this amount of waste-gases which is constant during the whole oxygen blowing period. If an amount of 4% carbon of the pig iron is burnt and the temperature behind the waste-heat boiler is 1,000° C., then the waste-heat boiler produces 0.9 ton of steam per ton of pig iron. The differential pressure-type scrubber operates with a differential pressure of 1,000 mm. of water, whereby an amount of 1 to 2 litres of water per m.³ NTP of gas is injected. The waste-gases contain then less than 0.1 g. dust per m.³ NTP of gas.

**Example 2**

The following data are obtained if 62 tons of pig iron are refined in an oxygen-converter and if the carbon content of the pig iron is burnt with a maximum combustion rate of 0.5% per minute. The data are:

- Oxygen blowing period: 16 minutes;
- Temperature of the waste-gas behind the waste-heat boiler: 1,000° C.;
- Amount of waste-gases on the mouth of the converter: 585 m.³ NTP per minute;
- Maximum heat operation rate of the waste-heat boiler: 267 × 10⁵ kcal. per minute;
- Steam production: 5 tons;
- Temperature of the waste-gases behind the differential pressure-type scrubber: 75° C.;
- Amount of waste-gases including watersteam of 75° C.: 1,300 m.³ NTP per minute;
- Whole pressure losses caused by the waste-heat boiler, the pipe-lines and the differential pressure scrubber: 1,300 mm. of water;
- Content of dust of the cleaned gases: less than 0.1 g. per m.³ NTP of gas.

Waste-heat boilers used for the process according to the present invention are generally known and described for example in Special Report No. 83, Fume Arrestment, Report of the Proceedings of the Autumn General Meeting of the Iron and Steel Institute, held at Church House Great Smith Street SW 1 on 26 and 27 Nov., 1963.

The differential pressure-type scrubber applied to the process according to the present invention is well known, too, and is described for example in "Krupp Technical Review," 1964, No. 3, 129-131, and in the journal "Staub" 21 (1961) No. 9, 418-425.


Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawing in which the single figure is a diagrammatic illustration of a system according to the present invention.

Referring now to the drawing, the same shows a system in which converter gases containing carbon monoxide at the mouth of a converter, in which pig iron is being refined by means of blowing oxygen, are drawn out by a suction-type ventilator or exhaust blower via conduit means that incorporate an open, cooled gas collector hood and a waste-heat boiler, i.e., a boiler in which the heat of waste gases is utilized. The blower is operated to produce a constant suction output. The gas collector hood, which is at that end of the conduit means that is arranged above the mouth of the converter, is provided with an annular jacket and, or, similar means. The jacket is in communication with the source of suction and has inlet means at the bottom so as to form an annular curtain of air between the lower end of the collector hood and the mouth of the converter. This collector hood thus enables the blower to draw in as much air as is necessary for burning off the converter gases in the waste-heat boiler, so that the carbon monoxide components of the converter gases can be burned off to the extent desired. If, however, the converter gases are not to be burned off, the air intake can be cut off completely by means of the gas collector hood.

Inasmuch as the blower operates to produce a constant suction during the oxygen blowing phase, more air will be drawn in through the hood at the start and at the end of the blowing phase than is needed for combusting the carbon monoxide components of the converter gases, while at the time of maximum carbon combustion, the air which flows in will not be enough for burning off the large amounts of converter gases that are produced for a short time. The collector hood prevents the converter gases from surging out. Both the burned-off components of the waste gases as well as the non-combusted components are then cleaned in a differential pressure-type scrubber which is set to operate at a constant pressure differential and which serves as a dust separator. After leaving the scrubber, the gas mixture is made to flow, under the influence of the blower, through a clean-gas stack at whose upper end there is formed a mouth. The flame burning at the mouth burns off the remaining non-combusted converter gases, and the mixture then passes into the atmosphere.

If the manner in which the oxygen blower takes place is changed, for example, if more oxygen is fed to the converter per unit time, the distribution of the converter gas quantities throughout the blowing phase will be changed. For example, the time at which the maximum carbon combustion occurs may be advanced so as to occur at the beginning of the blowing phase. In order to allow the system to accommodate itself to these different operating conditions, the suction output of the blower as well as the differential pressure of the scrubber will be changed so as to meet the requirements of the particular operating conditions, so as to enable the system to operate at constant suction and at a constant pressure differential even under the changed operating conditions. This may be done, for example, by adjusting the baffles arranged ahead of the blower, and by the adjustment shown symbolically at 5e. (These adjustments should not be confused with the regulating means described in the introduction, which are...
means which change the suction and the dust separation effect during the oxygen-blowing phase.)

It will thus be seen that, in accordance with the present invention, there is provided a method and apparatus which produce the following demonstrable advantages over the known prior art:

(1) The dust separator and the gas cooling arrangement can be kept substantially smaller, and the regulating systems can be dispensed with. Consequently, the initial costs are substantially less.

(2) Thanks to the fact that the regulating systems can be dispensed with, the operation of the system is far simpler.

(3) Since the complete combustion of the increased amount of as yet unscrubbed converter gases, which issues from the converter during that part of the blowing phase at which the most carbon is being burned, is prevented from being combusted in the waste-boiler as the result of there being insufficient air, the heating surfaces of the waste-boiler can be kept substantially smaller. The uncombusted converter gases are then scrubbed and burned off in a gas flame.

(4) Thanks to the open, cooled gas collector hood which is provided with the means for producing an annular curtain of air, a relatively large amount of steam can be produced while very little energy is used, i.e., the cost of the steam is kept exceedingly low. The reason for this is that due to the lower waste gas heat losses over the entire blowing phase, which result from the smaller quantities of waste gases and their lower temperatures, the heat regeneration is greater than the loss of heat energy which is produced as a result of the suppressed combustion of those quantities of converter gases which are produced during the time the most carbon is being burned. Also, the cooling losses of the waste-heat boiler are smaller due to smaller size and the fact that only a small part of the converter gases which are produced while the maximum carbon is being burned is combusted, which itself results in relatively low combustion temperatures in the waste-heat boiler.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and that the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. A method of drawing off the converter gases which are produced during an oxygen blowing iron refining process and of separating the dust from such gases, comprising the steps of
   (a) drawing off said converter gases, under a constant suction, during said refining process including the oxygen blowing phase thereof by means of a suction blower;
   (b) removing dust from the drawn off converter gases by means of an unregulated scrubber; and
   (c) limiting the intake of air at the mouth of the converter, in consequence of which the need for regulating said blower and said scrubber is eliminated.

2. A method as defined in claim 1 wherein said step (c) comprises providing an annular curtain of air that surrounds the mouth of the converter.

3. A method as defined in claim 1, further comprising the step of removing heat from the drawn off converter gases, thereby to allow utilization of the waste heat in the converter gases.

4. A method as defined in claim 3 wherein the complete combustion of increased amounts of the converter gases which are issued from the converter during the time when the maximum amount of carbon is being burned off is prevented, during said heat removing step, as the result of insufficient air, and wherein the non-combusted portion of the converter gases is burned off subsequent to said dust separating step.

5. A method as defined in claim 4 wherein the last-mentioned portion of the converter gases is burned off in a gas flame.

6. A method as defined in claim 1 wherein the suction and the dust separating rate are adjusted to the particular type of oxygen blowing operation being carried out in the converter.

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