Total Carbon in Raw Meal (Farin) Sample

Introduction

Emissions of carbon dioxide (CO_2) in cement production processes can be classified in two categories as direct and indirect emission. The direct CO_2 emissions mainly include the CO_2 emissions from chemical reactions in the cement production process (mainly from limestone calcination) and the CO_2 emissions from fossil fuel use for cement production [1]. Electricity consumption for cement production mainly causes indirect CO_2 emissions [2]. Fossil fuel combustion and electricity consumption cause direct and indirect CO_2 emissions, respectively. However, these emissions are usually considered as energy-related CO_2 emissions [1]. On the other hand, calcination reaction in the cement production process are usually called cement process CO_2 emissions. Calcination of calcium carbonate($CaCO_3$) and magnesium carbonate ($MgCO_3$) ,as in the reactions 1 and 2, in raw meal cause mainly CO_2 emissions. [3]

$$CaCO_3 \rightarrow CaO + CO_2 \quad (1)$$

$$MgCO_3 \rightarrow MgO + CO_2 \quad (2)$$

Cement production is a major source of CO_2 emissions in many countries and the estimation of the CO_2 emissions from cement production has attracted important attention. This carbon dioxide emissions can be calculated by using detailed input method based on analysis of the CO_2 released from total carbon (TC) of raw meal [4]. This application note reports total carbon (TC) results of raw meal samples which provides calculation of carbon dioxide (CO_2) emissions of cement process.

Principle of operation

Samples were dried in an oven at 95 ^{o}C over a night and then total carbon (TC) measurements were made with TRL-CN analyzer by HTCO method under the following conditions.

Table 1: Analysis Parameters

Parameters	Total Carbon (TC)
Decomposition furnace temperature	1100 ^{o}C
Catalytic furnace temperature	500 ^{o}C
Air pressure	2 bar
Air flow rate	3 L/min
NDIR gas flow rate	100 mL/min
Detector	NDIR

TC Analysis: Samples were carefully weighed in to quartz sample boat without any pretreatment and weights of the samples were input to the Trl-CN software. Quartz sample boats with compost samples were placed in the sample loading car. The sample was automatically moved into the decomposition reactor with the starting of the analysis. The total carbon concentrations of the sample was then calculated against the calibration curves created before.

Results

TC results and RSD values are shown in table 2.

Table 1: TC results

Repeat Number	Sample Size (mg)	TC Results (%)	Rsd (%)
1	300	9.50	2.28
2	303	9.08	
3	301	9.24	

Conclusions

In this study, total carbon in raw meal sample of a cement plant were analyzed with Trl-CN analyzer. The results showed high repeatability and reasonable RSD value with 2.28 %. Although complete decompositon of carbonates is complex, Trl-CN analyzer achieved to analyze TC content of raw meal samples with high sample loading and high repeatability. On the other hand, decomposition furnace temperature of Trl-CN were set to 1100 °C which provides simple and fast TC analysis of carbonates even high sample size.

References

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