Performance of Whatman Grade 42 quantitative ashless filter paper in sulfur content determination in cement industries

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Filter papers

Performance of Whatman™ Grade 42 quantitative ashless filter paper in sulfur content determination in cement industries

The aim of this work was to demonstrate the performance of Whatman quantitative ashless filter paper in specific cement industry applications. Grade 42 filter paper was evaluated in sulfur analysis, which is a cement test typically used in quality control laboratories. The results show the suitability of Whatman Grade 42 filter paper for this specific cement industry application.

Introduction

In cement industries, quality control (QC) laboratories routinely test the content of sulfur trioxide (SO_3) in cement samples. The sulfur trioxide level directly influences the quality of the cement. If the sulfur content is too high, the solidification speed of the cement will increase but the strength will decrease. Cement manufacturers need to maintain strict control of the SO_3 level to ensure a high quality of cement. Sample preparation is a critical factor in obtaining consistent results. Therefore, the use of high-quality, dedicated filter paper is expected to improve the accuracy of the QC test.

Whatman quantitative ashless filter papers from GE Healthcare Life Sciences (Fig 1) are made from pure cotton and treated to wash away most of the impurities. These quantitative ashless papers are useful for gravimetric analysis and the preparation of samples for instrumental analysis. Whatman quantitative filter paper gives high loading capacity and particle retention, both of which are useful for the analysis of sulfur and other substances in cement samples.

Fig 1. Whatman Grade 42 quantitative ashless filter paper.

Sulfur trioxide content determination in cement

In cement tests it is important to use high-quality filter paper with strict control over particle retention. During cement tests, two filtration steps need to be performed. The first filtration step removes gelatin in the liquid; Grade 41 filter paper is a suitable choice for this step. The second filtration step is critical to the test; Grade 42 filter paper is recommended to remove and retain the fine barium sulfate particles.

Materials and methods

The level of SO_3 is measured by adding barium chloride to the filtered sample under acidic conditions so that a barium sulfate precipitate is formed. This precipitate is then filtered, washed, burned, and weighed. The tests discussed here were performed at GE Healthcare laboratories.

Procedure

1. Cement powder (0.5 g) was weighed into a 200 ml beaker. Distilled water (40 ml) was added, and the contents were stirred until the sample dissolved. HCl (10 ml, 1:1) was added (Fig 2), and the sample was boiled for 5 min then cooled to room temperature. The cooled sample was filtered through Grade 41 quantitative ashless filter paper and washed with hot distilled water 10–12 times. Distilled water was added to the filtrate up to a volume of 250 ml. The solution was then heated to the boiling point.

Fig 2. Addition of sample and HCl to a beaker.

2. Barium chloride solution (10 ml, 10%) was heated to 50–60°C then added to the sample solution (Fig 3). The mixture was boiled for 3 min to form a precipitate. The sample was cooled to room temperature over 12–24 h.

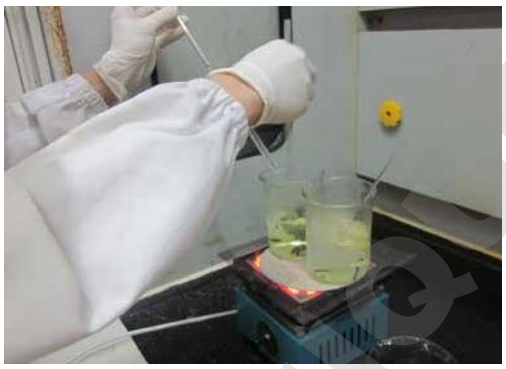


Fig 3. Addition of barium chloride solution to form a precipitate.

3. The second filtration step required Grade 42 quantitative ashless filter paper to retain the barium sulfate precipitate (Fig 4 A and B). The sample solution was filtered. The filter was then washed through with warm distilled water until no SO_3 could be detected in the filtrate when tested with 1% silver chloride.

(A)

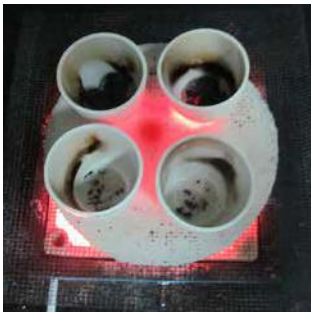
(B)

Fig 4 A and B. Second filtration step using Grade 42 filter paper.

4. The filter paper containing the barium sulfate was transferred into a pre-weighed crucible and heated until the paper was ashed (Fig 5 A and B). The crucible was then placed in an oven at 800–950°C for 30 min, put into a desiccator until it cooled to room temperature, and weighed. This procedure was repeated until the weight was constant. The amount of SO_3 was calculated using the following formula:

$$SO_3 = \frac{\text{Weight of precipitate} \times 0.343}{\text{Sample weight}} \times 100\%$$

(A) (B)



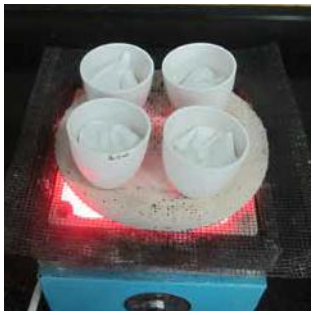


Fig 5 A and B. Ashing of paper containing barium sulfate.

Results and discussion

Grade 41 filter paper was used for the first filtration step, and Grade 42 filter paper was used for the second filtration step (Table 1). The data show that the use of Grade 42 quantitative filter paper gave very stable results with good repeatability.

Table 1. Filter papers used and amount of SO_3

Sample	1st filtration	2nd filtration	SO_3 content in cement
1	Grade 41	Grade 42	1.90%
2	Grade 41	Grade 42	1.81%
3	Grade 41	Grade 42	1.89%
4	Grade 41	Grade 42	1.87%
5	Grade 41	Grade 42	1.89%
6	Grade 41	Grade 42	1.83%
7	Grade 41	Grade 42	2.02%
8	Grade 41	Grade 42	2.07%
9	Grade 41	Grade 42	1.97%
10	Grade 41	Grade 42	1.98%

Conclusion

This work demonstrates that Grade 42 quantitative ashless filter paper is well suited to measure the level of SO_3 in cement and that it has the potential to improve the quality control process of cement.

Quantitative filter paper characteristics

Grade	Nominal particle retention in liquid (µm)	Filtration speed (approx) Herzberg (s)	Typical thickness (µm)	Basis weight (g/m²)	Ash content	Flow - aspect
42	2.5	1870	200	100	< 0.007%	Slow
41	20	54	220	85	< 0.007%	Fast

Ordering Information

Product	Quantity	Code number
Grade 41, Ø 9 cm	100 pcs/pk	1441-090
Grade 41, Ø 11 cm	100 pcs/pk	1441-110
Grade 41, Ø 12.5 cm	100 pcs/pk	1441-125
Grade 41, Ø 15 cm	100 pcs/pk	1441-150
Grade 41, Ø 18.5 cm	100 pcs/pk	1441-185
Grade 41, Ø 24 cm	100 pcs/pk	1441-240
Grade 42, Ø 9 cm	100 pcs/pk	1442-090
Grade 42, Ø 11 cm	100 pcs/pk	1442-110
Grade 42, Ø 12.5 cm	100 pcs/pk	1442-125
Grade 42, Ø 15 cm	100 pcs/pk	1442-150
Grade 42, Ø 18.5 cm	100 pcs/pk	1442-185
Grade 42, Ø 24 cm	100 pcs/pk	1442-240

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