Proficiency Test for Proximate Analysis of Coal: Determination of Moisture, Ash, Volatile Matter and Total Sulphur

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Abstract: Proficiency test (PT) is an important way of meeting the requirements of NABL accreditation (ISO/IEC 17025) in the areas of chemical testing. It provides laboratories with an objective means of assessing and demonstrating the reliability of data they produce. In this study, 18 laboratories interested in the ultimate analysis of coal participated in a proficiency test conducted by CSIR-National Metallurgical Laboratory, Jamshedpur in collaboration with CSIR-National Physical Laboratory, New Delhi in 2011-12. The participating laboratories used classical and instrumental methods of analysis to determine moisture, ash, volatile matter and total sulfur in a homogenized coal sample. This paper reports the analytical results and statistical evaluation of the results using z-score.

1. INTRODUCTION

Coal is the mainstay of Indian energy requirements and is widely used in power plants, ferrous and non ferrous industrial metallurgical processes. Accurate analysis of coal is important because critical decisions are made in industrial processes and accessing environmental pollution based on these analytical results. Coal available in different regions of India has wide variation in ash, volatile matter, and sulfur content and petrographic makeup. There are a large number of private and government laboratories in India for coal testing and proficiency testing (PT) in this area is important for quality assurance. A proficiency testing program (PT-Coal/2011-12) was organized by CSIR- National Metallurgical Laboratory, Jamshedpur in collaboration with CSIR-National Physical Laboratory, New Delhi in 2011-12 for analysis of Ash, Moisture, Volatile matter and total sulfur in coal sample. The purpose of the study was to assist participating laboratories in demonstrating their competence for analysis of coal sample by analytical techniques of their choice and to help labs to identify problems and opportunity of self improvement.

2. SAMPLE PREPARATION

The coal was collected from the identified mines of Jharkhand. It was crushed to 3-5 mm using jaw crusher and then air dried. It was pulverized to − 100 mesh and the resulting powder coal sample was homogenized using quarter coning method (IS 436 Part II, 1965), packed ~100g each in glass bottles and numbered. Participating laboratories were supplied 100 gram of sample each. Prior to distribution the samples were analyzed for homogeneity. Based on the results on randomly selected bottles testing, it was concluded that the samples were sufficiently homogeneous. Therefore, any results later identified as outliers could not be attributed to any significant sample variability. Laboratories were requested to perform the tests as they do in their routine analysis and follow to the given "Instructions to Participants" to record their results on the accompanying "Results Sheet", both of which formats were distributed to participants with the sample. Each laboratory was randomly allocated a unique code number for the PT program to enable confidentiality of results. Reference to each laboratory in this report is made by its code number.

3. RESULT & DISCUSSION

Eighteen laboratories participated in the PT program. Robust method was used for data analysis according to Annex C of ISO: 13528: 2005. In order to achieve the program's aim of assessing laboratories' testing performance, a robust statistical approach, which uses z-scores to assess participant's performance, has been utilized. The z-score is a measure of how far the result(s) is from the consensus value - a normalized value which gives a "score" to each result relative to the other results in the group. Therefore a z-score close to zero means that the result agrees well with those from other laboratories. An outlier will be any result(s) which has an absolute z-score value greater than three. Fig. 1 to 4 represented the z-score results of different participant labs. Lab ID is mentioned above the bar. Lab Id code 18 was found to be outlier for moisture whereas the results of Lab ID code 1 and 18 was questionable for VM (Z>2<3).

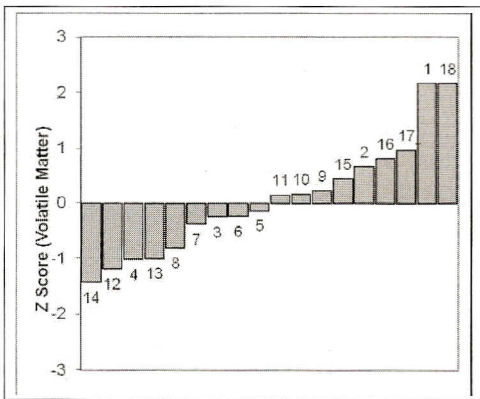Figure 1. Z-score of participant labs for moisture

Figure 2. Z-score of participant labs for VM

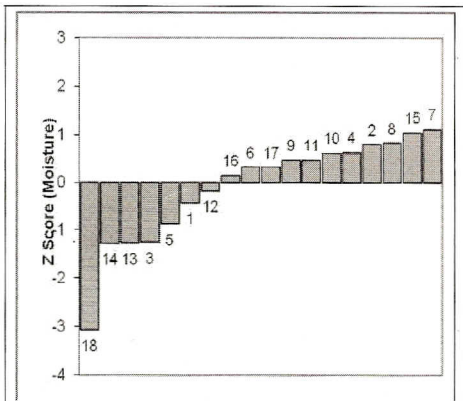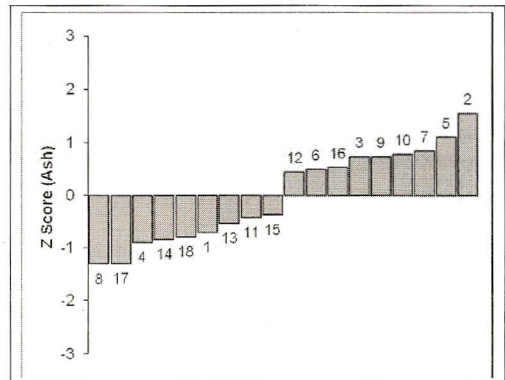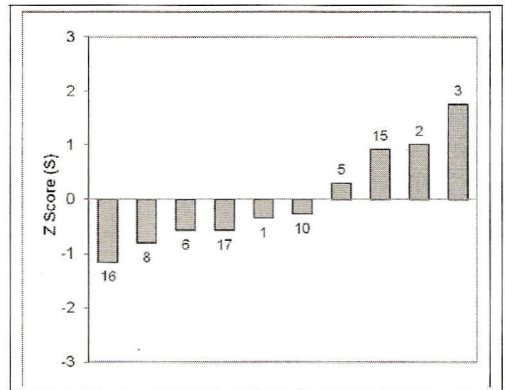
Figure 3. Z-score of participant labs for ash

Figure 4. Z-score of participant labs for Total Sulfur

4. REFERENCES

[1] IS: 436 Part II, 1965
[2] ISO: 13528: 2005 Statistical Methods for Use in Proficiency Testing by Interlaboratory comparison to determine the assigned value and the standard deviation.