Detection and quantification of air transparency from industrial air environment

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Abstract

Digital photography-based technique was developed to quantify plume opacity from digital photographs due to disadvantage of the currently used methods. The present study is designed to simplify the opacity monitoring process by the application of NI Labview program using digitized images from digital camera. The field tests demonstrated that this method have advantages when compared to in-stack transmissometer by their lower cost, improved objectivity, and availability of photographs of the visible emissions and their environments. Method 9 requires that an observer have an individual opacity error (15\%) and an average opacity error (7.5\%) for plumes during a particular test for the observer to be certified for 6 months. The individual and average opacity errors in the present study when compared to a reference in-stack transmissometer are within USEPA’s error limits for Method 9. These results indicate that both methods have the potential to serve as an alternative method to Method 9 to determine the opacity of plumes for regulatory compliance of stationary sources.

Introduction

Standards have been developed by the United States Environmental Protection Agency (USEPA) to regulate emissions of particulate matter from anthropogenic sources to protect the environment. The reduction of transmission of light and obscure the view of an object background due to plume emission is called as opacity. These emissions can be controlled base on percentage of opacity emission, Several techniques have been used as a measure of opacity. Four common methods are being used to measure opacity namely continuous opacity monitor of in-stack transmissometer, light detection and ranging system, visual determination of opacity by humans (Method 9) and digital photography-based techniques (DOM). DOM was developed to quantify plume opacity from digital photographs due to disadvantage of the above methods.
Materials and methods

The present study is designed to simplify the opacity monitoring process by the application of NI Labview program using digitized images from digital camera. In this study, DOM was developed to quantify plume opacity in daytime conditions, using calibrated digital camera assisted with a NI Labview digital image processing technique. To test the ability of DOM in estimating plume opacity under natural conditions in two field campaigns were tested at Illinois EPA-certified smoke school, USEPA acceptable limits of 15% of Individual opacity error and 7.5% of average opacity error are the criteria to verify the performance of the DOM.

Fig. 1. Comparison of individual opacity errors of DOM with Transmissometer (+15%).

Fig. 2. Comparison of average opacity errors of DOM with Transmissometer (7.5%).