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Technical Considerations in the Design of Capture Systems to Control Fugitive Releases in Ironmaking and Steelmaking

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The adequate design of ventilation systems for the capture of hot, fugitive releases from ironmaking and steelmaking operations requires good estimation of fume release rates and temperatures, whether it be for short term operations such as scrap charging into an EAF, or for operations that can be adequately characterized as continuous releases, such as melting and refining. There are various methods and techniques used to estimate release rates, including empirical tools such as the Hemeon & EPA methods, plume photography and video analysis, scaled-down physical models, as well as CFD based simulation methods. This paper describes some of the assumptions involved and comparisons between these various methods, and how they can impact the sizing of the capture system (i.e., canopy hood design, ventilation exhaust flow specification, etc.). Some key technical considerations are highlighted when using these various methods, which can greatly influence the design of the capture system. These include, as examples, 1) paying careful attention to the height of a developing, buoyant plume versus a fully developed plume that most empirical methods are based on, 2) the location above the emissions source where plume photography is taken and used for plume flow estimation, 3) a consideration for the impact that obstructions (such as crane rails, scrap buckets, etc.) and wind cross-drafts can have on the plume deflection and movement. This paper demonstrates how CFD modeling, which is a first principles-based method, is better able to predict more realistic plume behavior under the conditions, and the resulting impact on the design of the fume capture systems.

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