Estimation of Cost Curve to Control Sulfur Dioxide Gas (SO2) Emissions from Sarcheshmeh Copper Complex

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Introduction: Sarcheshmeh Copper Mine is regarded as the second largest copper deposit in the world. This is one of the largest industrial-mining complexes in the world and the largest producer of copper in Iran. This complex plays an important role in Iran's economy. In 2012, this complex created employment for about 8000 people in Iran and produced 203065 tons of copper cathodes.
However, high amounts of pollutants are being produced and emitting into the environment from this complex. SO2 is the main type of air pollutant emitted from its smelter factory. This complex emits about 789.9 tons of SO2 per day.
The necessity to protect the environment is an indisputable principle which has been accepted by everyone in today's world. Therefore, pollutant emissions from manufacturing firms are regulated to protect human and environment health. Although the potential benefits of industrial pollution control are clear, policy makers worry about the costs. The development of pollution abatement policies and technologies require information on emission control potentials and their costs. Abatement cost curves (ACCs) are powerful management tools. These tools greatly improve the transparency of pollution-reduction information. Therefore, the SO2 ACC is constructed in this study for Sarcheshmeh Copper Complex to determine the potentials and costs of SO2 abatement.
Material and methods: Abatement cost curve shows the annual abatement cost per unit of avoided emissions of pollution. The Marginal Abatement Cost Curve (MACC) links a firm's emission levels and the cost of additional units of pollution reduction.
There are a number of methods available at varying levels of complexity and scale to create ACCs. Methods which focus on technological details and the impact on individual enterprise are classified as bottom-up measures. The economy wide impact of abatement costs are investigated by top-down measures. Due to the small spatial scale of this study, the most suitable approach is a bottom-up study. A stepwise methodology was applied. There are four steps to the methodology:
1. Identification of the available abatement techniques;
2. Calculation of total cost and abatement potential for all techniques, and identification of possible combinations and incompatibilities;
In an analysis of the industrial processes, investment and operation and maintenance (O&M) costs must be taken into consideration. In this study, energy, labor, insurance, depreciation, overheads, materials, maintenance, and repair were considered as O&M costs. Various methods can be employed for estimating investment costs. In this study, the power factor applied to plant-capacity ratio method was used for estimating investment costs. This method for studying or order-of-magnitude estimates relates the capital investment of a new process plant to the capital investment of similar previously constructed plants by an exponential power ratio. That is, for certain similar process plant configurations, the capital investment of the new facility () is equal to the capital investment of the constructed facility C multiplied by the ratio R. This is defined as the capacity of the new facility divided by the capacity of the old, raised to a power x (Eq. 1). This power has been found to average between 0.6 and 0.7 for many process facilities.
Several studies have estimated investment and O&M costs of SO2 abatement. This study used Islas and Shafizadeh's studies for estimating costs.
3. Manipulation and standardization of data;
4. Derivation of the abatement cost curves.
Results and conclusions: Five SO2 abatement technologies were assumed. The costs of the five techniques were estimated for Sarcheshmeh Copper Complex. The cost data were divided into investment and O&M costs. SO2 abatement costs were calculated using a discount rate of 20%, a time horizon of 15 years (2012-2027). Fig. 1 shows the calculated SO2 abatement cost curve for the complex. This curve shows the annual SO2 abatement cost per tons of avoided SO2 emissions. The SO2 abatement cost varies from US$4 to US$604/ton of SO2.

Keywords: abatement cost curve, engineering, economic method, marginal abatement cost curve, Sarcheshmeh copper complex, SO2