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Research Paper

Using the Analytical Hierarchy Process to Study the Industrial Air Pollution Control Equipment: Optimal Choice

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1. ABSTRACT

Undoubtedly, the air pollution issue is one of the most prominent problems in today's societies. Therefore, one of the human goals is to enhance air quality. The main challenge in this paper is to choose the best air pollution control equipment based on the perspective of an analytical hierarchical process (AHP). The AHP is a multifaceted method of decision-making based on different regulations in order to achieve logical consequences, which Expert Choice software was employed. Cost parameters (operational and material), yield, environmental regulations, pollution sources and operating conditions are selected as process criteria. Also, cyclone separators, scrubbers, electrostatic precipitators, and fabric or bag filters are alternatives for this process. Due to a pairwise comparison of criteria, sub-criteria and alternatives in software, the electrostatic precipitator was chosen as the best control equipment with a preference of 38% over other apparatus. Also, the cost criterion was the most preferred with 31.2%.

Keywords: Electrostatic Precipitators; Expert Choice Software; Air Pollution

2. INTRODUCTION

Nearly 3 million people die every year due to air pollution, 90% of which are in developed countries. Among the various methods to control environmental pollution, the use of air pollution control equipment can be very effective. In fact, primary particulate matter control is an essential part of any air pollution control engineering department. Various equipment such as cyclone separators, scrubbers, electrostatic precipitators and bag (fabric) filters are applied to control industrial pollution. Scrubbers are dust collectors that are employed to remove contaminants from the wet fluid. Electrostatic precipitators contain a filter that separates the particles in the gas by creating an electric field. Bag filters (fabric) can be called one of the most important and efficient types of air pollution control equipment. These dust collectors include one or more rows of fabric bags with a porous bed. One of the most common and simple air pollution devices is a cyclone separator. Based on the lack of useful data in the field of optimal selection of air pollution control equipment, in this article, the Analytical Hierarchy Process (AHP) was employed to systematically and logically select the best device [1-4].

3. MATERIALS AND METHODS

One of the most systems designed for decision-making with multiple criteria is the analytical hierarchy process (AHP) approach. The analytical hierarchy process is based on the programmed pairwise comparison, which makes calculations accurate. In this method, Expert Choice software can be used for the analytical hierarchy process [5-7]. Cost (operational and material), yield, environmental regulations, pollution sources and operating conditions are selected as criteria, and cyclone separators, scrubbers, electrostatic precipitators, and bag filters are chosen as alternatives. The flowchart of the analytical hierarchy process is demonstrated in figure 1.

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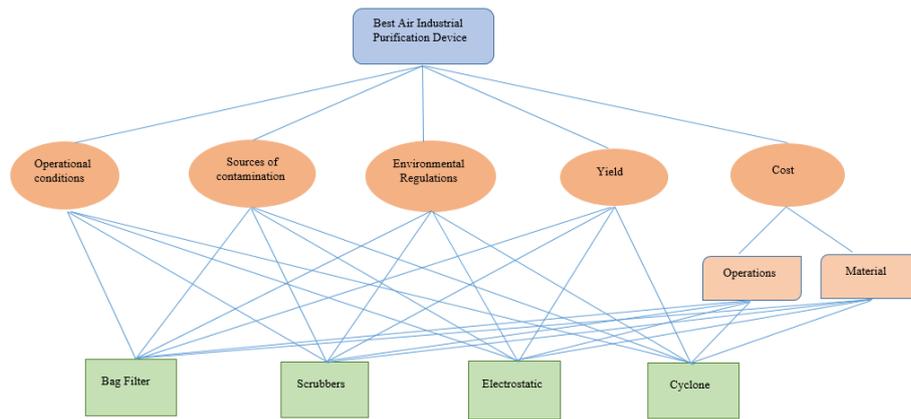


Fig 1. Process view of the criteria and alternatives of the hierarchical analysis process

4. RESULTS AND DISCUSSION

A pairwise comparison between the criteria was organized based on the previous studies, and the software was employed for pairwise comparison. The preference of each of criteria (parameter) and alternatives (air pollution control equipment) have been analyzed and compared based on the existing situation in the process. It is obvious that the alternatives for this process have advantages and disadvantages, and these parameters must be carefully studied and checked for pairwise comparison. According to figure 2 and 3, the electrostatic precipitators and cost has the highest priority among other alternatives and criteria, respectively.

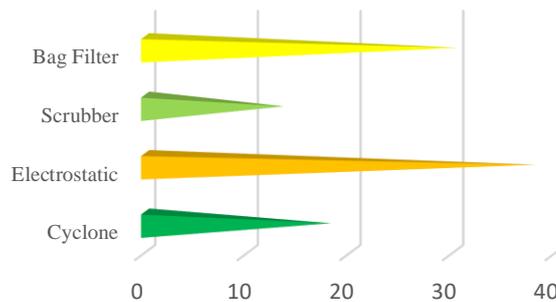


Fig 2. Pairwise comparison of alternatives in Expert Choice software

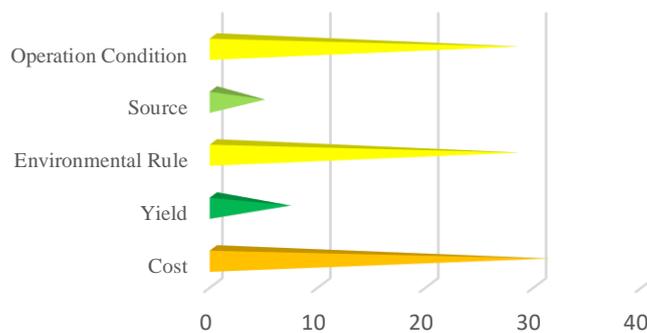


Fig 3. Pairwise comparison of criteria in Expert Choice software

5. CONCLUSION

In this article, the optimal selection of air pollution control equipment was investigated. Considering the multitude of available methods, the AHP was applied to select the logical method for optimal selection. The results indicate that the cost criteria (operations and materials) have the most priority with a priority of 31.2. Also, the electrostatic precipitator with a slight difference compared to the bag filter has 38% priority.

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