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Selection of Main Mechanical Ventilators for Underground Coal Mines

A Case Study

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Preface

The main mechanical ventilator for underground coal mines is one of the most expensive items governing the productivity, safety and profitability of a mine. It requires the most tactical and strategic planning as it affects the capital and revenue expenditure of the mine for its whole life. To select a main mechanical ventilator, optimally ensuring lowest overall cost for the whole life of a mine needs elaborate, scientific and techno-commercial considerations. The ventilation requirement of any underground mine is not a static quantity, but rather it changes dynamically. In a modern mechanized coal mine, the ranges of ventilation requirements are wide and selection of main mechanical ventilators is a complex techno-economic decision. Many times, the selection of the operating point is carried out manually at the intersection point of the mine characteristics curve and fan characteristics curve, which is qualitative, cumbersome and prone to error. Moreover, the operating point is also dynamic in nature and should be selected quantitatively considering dynamic changes in both mine characteristics curve and fan characteristics curve. This book aims to provide a user friendly, reliable, quantitative and software driven solution for selecting the main mechanical ventilator for underground coal mines.

I had three goals in writing this book.

Structured Approach: I planned to elaborate on the methodology of selection of main mechanical ventilators covering technical and economic considerations. As this is a very complex decision, I tried to explain the precautions to be taken during technical considerations so that a fan is selected optimally. Every mine operator desires to reduce the ventilation cost and I tried to cover all possible technical variants in respect of centrifugal as well as axial flow ventilators used in underground coal mines.

Computer Program: I tried to provide the algorithm for selection of main mechanical ventilators so that practicing mining engineers, regulators, researchers and mine operators can develop their own code in their preferred high level language using the discussed algorithm. The developed program considers the environmental requirements, regulatory conditions and the occupational health related issues of the underground coal mine so that the working conditions of an underground environment may be maintained as productive, healthy and safe at all times.

Case Study: The case study also provides a platform to demonstrate the discussed technology and methodology. I tried to cover an Indian case study where the equivalent resistance of the mine was computed using ventilation network analysis software. The same network was used for selection of main mechanical ventilators out of nine variants of mechanical ventilator. The graphical output table showing technical and cost parameters for case study mines has been discussed in details.

This book offers a framework for selecting the most techno-economic fan for any mining condition judiciously, accurately, reliably, quickly and effectively by suggesting the suitable mechanical ventilator, which can deliver the required quantity of air at the lowest cost. Chapter 1 summarizes all design considerations, technical complexities in selecting the main ventilator and key factors responsible for selection of main mechanical ventilators to suit a given mining condition. It provides a holistic review of the needs and difficulties in fan selection. Chapter 2 emphasizes the various methods used for carrying out a ventilation network analysis. Chapter 3 addresses the method of fan selection incorporating all technical considerations and economic considerations. Chapter 4 discusses all possible ways to reduce the ventilation cost as well as a number of technical variants for achieving significant energy savings. Chapter 5 contains the computer code developed in 'C' language for selecting the techno-economic ventilator to suit a particular mining condition. The data handling, operation, source compiling and limitation of the program are also discussed. Chapter 6 demonstrates the use of computer programs by covering an Indian case study. The particulars of all data files, program outputs and discussions on results are analyzed in this chapter.

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My heartfelt gratitude and sincere thanks to the Almighty for seeing me through during very difficult times, providing my inner strength to overcome tough times and answering my prayers during times of need.

Kolkata, West Bengal, India Ajay Kumar Jha

Contents

1 Importance and Characteristics of Main Mechanical Ventilator 1
1.1 Introduction 1
1.2 Characteristics of Main Mechanical Ventilator 2
1.3 Prime Factors for Selection of Main Mechanical Ventilator 3
1.4 Complexities in Selection of Main Mechanical Ventilator 3
1.5 Summary of the Chapter 5
References 5

2 Ventilation Network Analysis 7
2.1 Introduction 7
2.2 Analytical Method 8
2.3 Numerical Method 8
2.4 Hardy Cross Method 9
2.5 Monte Carlo Method 10
2.6 Ventilation Modeling 10
2.7 Summary of the Chapter 15
References 15

3 Method of Selection of Main Mechanical Ventilator 17
3.1 Introduction 17
3.2 An Overview of Technical Considerations 17
3.3 Precautions to Be Taken During Technical Considerations 19
3.4 Economic Considerations 20
3.5 Summary of the Chapter 23
References 23

4 Possible Ways for Reducing the Ventilation Cost 25
4.1 Introduction 25
4.2 Methods of Reducing the Ventilation Cost 25
4.2.1 Reducing the Pressure/Head Loss due to Mine Resistance 26
4.2.2 Selecting a Fan with the Highest Possible Efficiency 27

4.2.3 Reducing the Gas Amount Using Methane Drainage in Very Gassy Mines 27
4.2.4 Reducing All Air Leakages to a Minimum 28
4.2.5 Reducing the Resistance of Mine Shaft 28
4.3 Flow Control and Energy Saving 28
4.3.1 Constant Speed of Drive and Fan with Capacity Control by Devices Which Modify the Fan or the System Characteristics 29
4.3.2 Constant Speed Drive with Provision for Variation of Fan Speed by Auxiliary Intermediate Devices Between the Fan and the Drive 29
4.3.3 Variable Speed Drive Directly Coupled to the Fan 29
4.3.4 Deblading 29
4.3.5 Variable Volume or Variable Geometry Mechanisms 30
4.4 Facilities to Regulate Ventilation in Mechanical Ventilator in Axial Flow Fan 30
4.4.1 Airfoils 34
4.4.2 Casing 40
4.4.3 Collector 40
4.4.4 Cowl 40
4.4.5 Diffuser 40
4.4.6 Blades 41
4.5 Summary of the Chapter 41
References 41

5 Computer Program for Fan Selection 43
5.1 Introduction 43
5.2 Algorithm 43
5.3 User's Guide and Data Handling 44
5.3.1 Data Files Used by the FAN.EXE Program 44
5.3.2 Preparing Cost Parameters Data File 45
5.3.3 Preparing Fan Characteristics Data File 46
5.3.4 Preparing Efficiency Data File 46
5.3.5 Preparing Power Data File 46
5.3.6 Important Note 46
5.4 Running the Program and Compiling the Program 46
5.4.1 Compiling the Source 47
5.5 Limitation of the Program 47
5.6 Summary of the Chapter 47
References 48

6 Application of the Computer Program: An Indian Case Study 49
6.1 Introduction 49
6.2 Particulars of Data Files 50
6.3 Program Output Including Graphical Output 52

6.4 Interpretation Drawn from Program Output 52
6.4.1 Discussion on FAN-1 53
6.4.2 Discussion on FAN-2 53
6.4.3 Discussion of FAN-3 54
6.4.4 Discussion of FAN-4 55
6.4.5 Discussion on FAN-5 56
6.4.6 Discussion of FAN-6 57
6.4.7 Discussion on FAN-7 57
6.4.8 Discussion on FAN-8 58
6.4.9 Discussion of FAN-9 58
6.5 Conclusions Drawn from Program Output 59
6.6 Summary of the Chapter 74

Annexure-I 77