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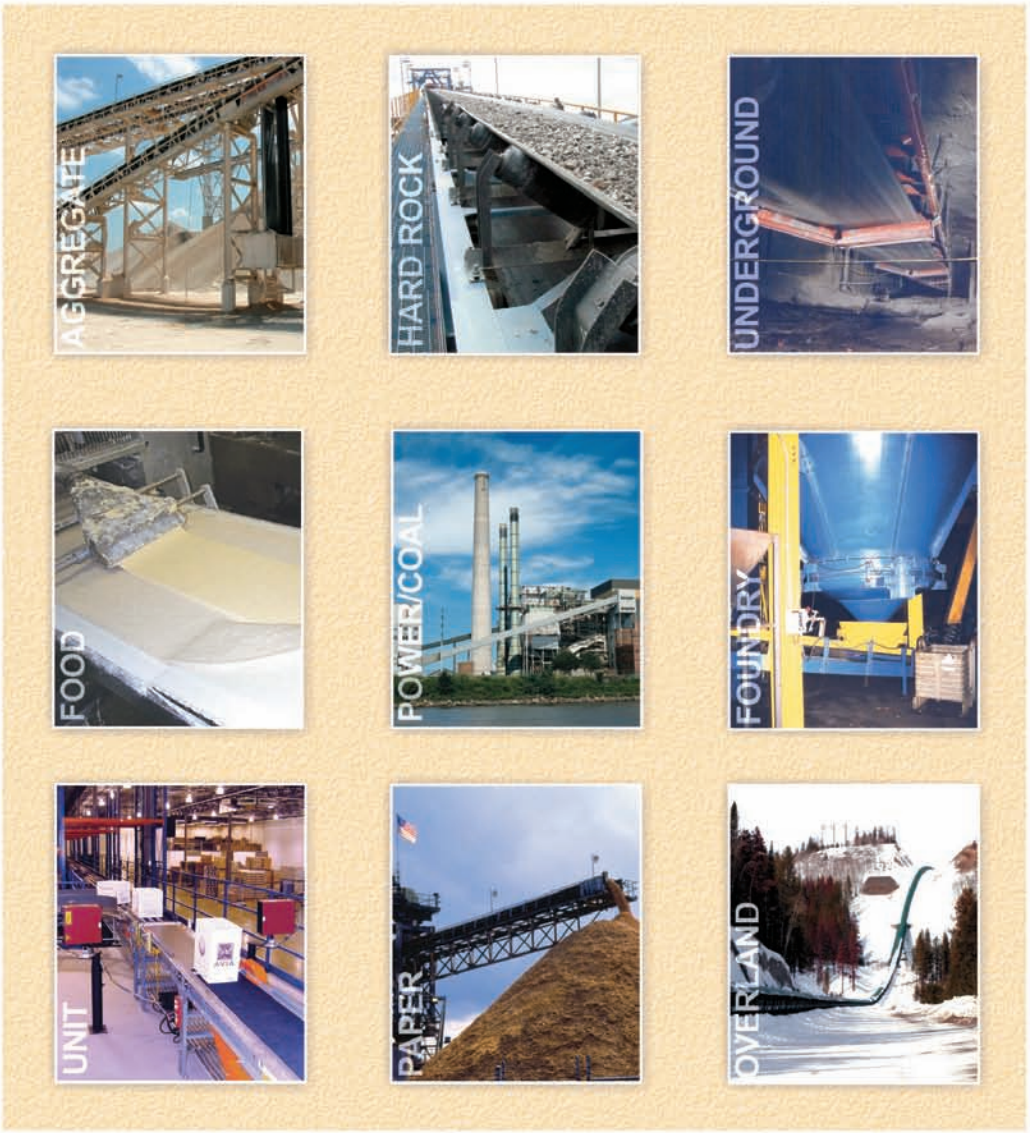
BELT CONVEYORS for BULK MATERIALS

Prepared by the Engineering Conference of the

CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION



SIXTH EDITION
2nd Printing

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PREFACE

The goal of this book is to be the definitive resource to experienced conveyor engineers on the design, installation, operation, and maintenance of belt conveyors for bulk materials. An experienced conveyor engineer, by following the methods in this book, can be greatly assisted in the design a bulk material conveyor that will be efficient and reliable at a level of quality that reflects a systems approach to design and operation and meets the user's expectations.

Experienced conveyor engineers can use the information and engineering principals put forth to design virtually any width, length, configuration and capacity of bulk materials handling belt conveyor and predict its performance within an acceptable range. Interested parties can also gain a basic understanding of the engineering, selection of components, related equipment and accessories and applications for belt conveyors.

The information presented in this book is intended to cover the basic principles of belt conveyor design and to include such formulas, tables, charts and recommendations as are required to design most belt conveyors. The material is arranged in the order most convenient for the use of an experienced conveyor engineer. As always, the responsibility for the ultimate safety, reliability, and functionality of any conveyor system rests with those who design and build it.

While the formulas, recommendations and data are based on industry practice and are believed to be reliable, CEMA does not, and can not, assume any role in, or responsibility for, the safety, reliability or functionality of any conveyor system or component which it did not design. The formulas and principles in this book are guidelines only and are applicable to the design of a high percentage of conveyors that are required to operate under reasonably normal conditions. However, conveyor design is as much art as it is science and some conveyors will operate under conditions that are beyond the scope of this book. These design challenges require broad experience for a satisfactory solution. A qualified designer or engineer from a CEMA member company should be consulted in such cases, as well as in the design of conveyors critical to a process, very wide or fast conveyors and complex conveyor systems.

ACKNOWLEDGEMENTS

The Conveyor Equipment Manufacturers Association is indebted to the members of The Engineering Conference, The General Bulk Material Handling Section, The Unit Handling Conveying Section, and the many other individuals who contributed their time, effort and resources to the planning and compilation of this book; to the member companies who made available the time and talent of their engineers, draftspersons and marketing specialists; to the non-member companies, technical associations and professional societies for their assistance in making this book a reality.

CEMA and all of its members would like to express our appreciation to R. Todd Swinderman for his work in organizing, writing and producing this 6th Edition of the Belt Book. We are most grateful for his extraordinary effort and dedication without which this book would never have been completed.

INTRODUCTION

The development of belt conveyors, capable of transporting virtually any bulk material at thousands of tons per hour in a continuous and uniform stream, has been one of the most important innovations for modern industry. Its history dates back to 1830 when sawmills applied flat belts sliding in steel troughs to move sawmill refuse and other materials away from milling operations. In the 1850's, the grain industry evolved the first conveyors designed to reduce the friction of rubber sliding in a steel trough by replacing the trough with a series of pulleys, with end discs separated by bent bars, to form a cup for troughing a leather belt. These leather troughed belt conveyors were successfully applied in many grain elevators during the 1860's through 1880 as refinements in the bent bar pulley design led to spooled wooden drums with shafts supported in bearings.

It wasn't until 1891 that rubber belt conveyors were applied to handling heavy bulk materials previously considered transportable only by mobile equipment and gravity. Prior to this, ore processing plants were always built into the side of a hill, eliminating the need for horizontal transport by belt conveyor. In 1891, Thomas Edison experimented with flat belt conveyors similar to those used in the grain handling industry to move heavy, abrasive ore at his iron mine and processing complex in Ogdensburg, New Jersey. The belts were simply a cotton duck material. It soon became apparent that the cotton belts and wooden idlers were no match for the heavy and abrasive ore. Replacement of the belt and idlers became necessary on a one to two month cycle.

In that same year, Thomas Robins Sr. approached Mr. Edison and convinced him to try a cotton duck belt with a 1/8" rubber cover. Edison agreed and the new belt proved to be the wear solution. A working relationship began between the two inventors and Robins persuaded Edison to try a troughed belt configuration using spool shaped idlers to form the trough. This proved to be a failure because the upper edge of the spool moved at a higher speed than the base of the trough, causing damage to the underside of the belt from frictional resistance. The solution recommended by Robins was to break the spool into three independent cylindrical pulleys, each supported by a bearing at the ends of its shaft. These two innovations, the rubber belt covers and three roll idler, became the foundation for modern belt conveyor design and the origin of the Hewitt-Robins Company, a founding member of CEMA, in 1933.

In the ensuing years, the demand for higher capacities, longer runs, steeper conveying angles, and energy efficiency has led to new innovations and technologies. Belt conveyors with capacities reaching 20,000 tons per hour, lengths exceeding 30 miles, horizontal curves, and inclinations to vertical are covered in this Sixth Edition. In addition, the costs per ton-mile to transport various materials are illustrated, based on proven experience at different operating sites. The technical information contained in this book is generally conservative in nature. Variations in specific application requirements or extreme service requirements should always be addressed by member company engineering personnel whose depth of experience exceeds that covered in this text.

In the first edition of this book, the Conveyor Equipment Manufacturers Association (CEMA) stated its objectives to make available the experience and technical knowledge of its members as a contribution toward the design and construction of conveyors of superior performance, and also to provide basic data and fundamentals of design for application to ordinary belt conveyor problems in order to achieve successful performance. Adhering to these same objectives, CEMA is pleased to offer this Sixth Edition of *Belt Conveyors for Bulk Materials*.

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