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Analysis of Dynamic Mechanic Belt Stresses of the Magistral Conveyor

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Abstract. Controlling the amount of material flow coming from the input accumulate bunker to the input of the conveyor line and controlling the speed of the conveyor belt are common ways to reduce the energy consumption of the transport system. However, most works do not take into account transients associated with a change in the speed of the conveyor belt or a change in the input material flow. As a result of transient processes, acceleration or deceleration of the conveyor belt occurs, and as a result, dynamic stresses arise in the conveyor belt, which can exceed the permissible values. This article examines the dynamic stresses that occur during transient modes. When constructing a model of dynamic stresses, Hooke's law was used. The model of resistance to movement of the conveyor belt is adopted in accordance with DIN 22101: 2002-08. The analysis of the propagation of waves of dynamic stresses in the conveyor belt has done. The formation of dynamic stresses as a result of the addition of the forward and backward waves is considered.

Keywords: Dynamic Tension, Conveyor Belt, Acceleration, Propagation Speed of Disturbances, Tension Force, Oscillatory Process

1 Introduction

The coming of conveyor transport in the mining industry has radically changed the technology of rock mining [1,2]. The applying of conveyor transport has led to lower energy costs and the complexity of mining rock [3,4]. The use of conveyor systems has significantly improved the performance and throughput of the transport system [. The characteristics of modern conveyor systems are presented in [5,6] (table 1). The non-stationary value of the incoming rock flow to the entrance of the conveyor section leads to an uneven distribution of material on the conveyor belt along the transportation route [7,8]. This leads to an increase in the specific energy consumption for the transportation of one ton of material [9]. To reduce specific energy consumption, they regulate con-

veyor belt speed [10,11,12] or the value of input material flow coming from the accumulating hopper [13,14,15]. Such regulation is the cause of acceleration or deceleration of individual sections of the conveyor belt [5, 16].

Table 1. Characteristics of conveyor transport systems

	length (km)	sections	power (kW)	speed (m/sec)	capacity (t/h)
The Channar Overland, Western Australia (1989) [1]	20.4	2 (10.4; 10.1)	4200	4.1	2200
Neyveli Lignite Corp., India (2007), [2]	14	8	2520	5.4	
Çöllolar Lignite Open Pit Mine, Turkey (2011), [2]	17.4	26	46300		9350
Coarse ore conveyor system Minera Los Pelambres, Chile (1998), [2]	12.7	3	25000		8700
Open Cast Mine Reichwalde, Germany (2010), [2]	13.5	6	19350	5.5	6000
From a mine in India to a cement plant in Bangladesh (2005), [3]	16.5	1		6.5	
Sasol's Impumelelo project in South Africa (2015), [3]	27.5	1		6.5	2400
From the Bu Craa mine to the coast at El Aaiún, Western Sahara, [3]	128.7	11			2000
The Henderson Coarse Ore Conveying System, the North American Continental Divide (2000), [4,5]	24	3	12700	4.5	2270
Tianjin China Port Authority, China (2005) [6]	8.98	1	4x1500	5.6	6000
Barcelona Tunnel (the Metro (Train) Extension Project), Spain (2005) [6]	4.71	1		3.5	1500
Baumgartner Tunnel, the Metropolitan St. Louis (Missouri), USA [6]	6.18			2.54	200

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