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Stability of Mine Car Motion in Curves of Invariable and Variable Radii

Task of determining working conditions and development of corresponding technical measures to provide mine car lifetime and safety improvement which play a big role in labor protection and technical and economic indices.

High abrasiveness of transportable materials, atmospheric suspension aggressiveness, high air moisture, dynamic load on running gear due to track imperfection and excavation characteristics are the characteristics of conditions of mine car workspace. Miner car operational life depends on mineral physical-mechanical properties. Operation life of mine car is 3-4 years (according to documents is 5 years), for mine car basket is 2-4 years, for wheelpairs is 1-2 years, for coupling is from 6 months to 2 years.

Dynamic loads appearing while operation of mine car at track conditions are the cause of axle-boxes fast deterioration and failure, carriage underframe and basket deformation and towing coupler damage. The biggest dynamic constituent is the main characteristic while going through the rail joint and other imperfections.

The cause of one-sided frictional contact of wheelpair and rail is insufficient wheelset's radial self-adjustment, which causes intensive wear of bands' and rails' work surfaces and axle-boxes bearings at curved track section and when descending from it. It causes also high dynamic load on sections of tub's running gear.

The task of the project is decreasing dynamic loads, which running gear takes while moving at curved and straight track section and increasing car motion margin of durability when crawling wheel on rail using construction improvement of rail gear. Simulator development is necessary condition for dynamical processes and motion parameters of mine car with independently mounted wheel comprehensive studying in underground opening which would describe mine car operation while using different tracks. Lagrangian equation set in generalized coordinates is the basis for system with finite degree quantity of freedom variation investigation. Equations are taking into account the fact that all constraints of the system are ideal and have no reactions. Values that define system motion are directly connected with given forces. The task of determining margin coefficient of durability to choose the rational parameters of viscoelastic elements is solved by differential equation set and reaction lateral component definition, which appears in mine car output links.

Ways of increasing margin durability for crawling wheel on rail using addition of kinematic mobility to sections of running gear are valued. The simulator of mine car motion with wheel pairs differential rotation when interacting with track is created and margin of durability value is calculated. Margin coefficient of durability on track of small fillet is also calculated. This value corresponds real conditions of excavation.