EJECTING PROPERTIES OF A BUCKET ELEVATOR

O. A. Averkova*, I.N. Logachev* and K.I. Logachev*

* Belgorod State Technological University named after V.G. Shukhov
(BSTU named after V.G. Shukhov), 308012 Belgorod, Russia
e-mail: kilogachev@mail.ru, web page: http://www.bstu.ru

ABSTRACT

Air inside the enclosure of a belt elevator may be brought into motion both by moving bucket belt and by spillage flows during loading and unloading of buckets. Initial findings from studies performed to evaluate air motion in ducts with mobile partitions have been published in our earlier monographs [24, 53]. Here we'll consider the process of air ejection in bucket elevators from the standpoint of classical laws of change in air mass and momentum.

Direction of airflow inside enclosures of the carrying and return runs of a bucket elevator is determined by the drag of buckets and moving conveyor belt as well as ejection head created by a stream of spilled particles when buckets are unloaded. As a result of these forces acting together inside an enclosure, differential pressure arises. This differential pressure is equal to the sum total of ejection heads created by conveyor belt with buckets E_k and flow rate of spilled material E_p minus aerodynamic drag of enclosure walls.

The ejection head E_k created by a bucket-carrying conveyor belt is determined by aerodynamic coefficient c_{ek} (proportional to the number of buckets, their head resistances and squared mid-sectional dimensions) together with an absolute value and the direction of bucket velocity relative to the velocity of airflow inside the enclosure.

Ejection head of spilled particles E_p depends on the drag coefficient of particles, their size and flow rate, as well as the enclosure length, enclosure cross-section and relative flow velocity of particles.

When both the carrying and return runs of the conveyor belt are located in a common enclosure, the velocity of forward airflow varies over its length as a result of cross-flows of air through gaps between the conveyor runs and enclosure walls. Cross-flows are caused by a differential pressure between the carrying and return run enclosures and is dependent on the drag of the gap. Cross-flow direction depends on the ratio between p_v and p_u.

Given identical size of elevator enclosures, change in absolute values of longitudinal velocities is identical and depends on absolute values of cross-flow velocities and geometrical dimensions of the gap, as well as enclosure cross-section. The momentum of longitudinal airflow in this case is determined by variable magnitudes of aerodynamic forces of buckets due to changes in their relative motion velocities.

The flow rate of air in enclosures may be determined by numerically integrating three dimensionless combined differential equations.

REFERENCES

[1] O. D. Neikov and I.N. Logachev. *Suction and air dedusting in production of powders*. Moscow: Metallurgiya, 1981. 124 p.

[2] I. N. Logachev. Aspiration in loose-matter handling systems of agglomeration shops // *Local exhaust ventilation*. Moscow, Moscow House for Research and Engineering Information (MDNTI), 93–106 (1969).

[3] I.N. Logachev and K.I. Logachev. *Industrial Air Quality And Ventilation: Controlling Dust Emissions*. Boca Raton: CRC Press, 2014.