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Methods of Reducing the Accident Rate of Technological Vehicles of the Airport

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Abstract

This study proposes a way to reduce accidents at the airport. Accidents involving technological vehicles of the airport and aircraft located in the parking lot, maintenance, or movement on the territory of the airport are considered. The proposed method is based on the introduction into the operation of the technological vehicle of the airport of an additional means of controlling the parameters of the movement of the vehicle, including speed and traffic, duration and working time of the driver, etc.

Keywords: Technological Vehicles; Airport; Control; Parameters.

1. Introduction

Reducing the accident rate in aviation is one of the main tasks in transport in the 21st century. Accidents involving air transport often lead to significant loss of life and property damage (Fig. 1) (Lykou et al., 2020; ICAO Safety Report, 2020; Runway Safety Accident Analysis Report, 2020).

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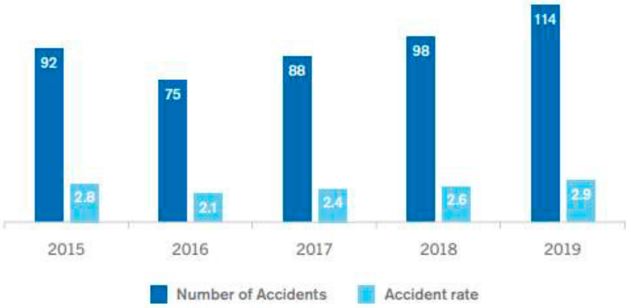

Fig. 1. Accident records: 2015–2019 scheduled commercial operations (ICAO Safety Report, 2020).

Moreover, such accidents occur not only in the air but also on the ground, a collision at the Hong Kong airport can serve as an example of such events (Fig. 2).

Fig. 2. Accident at Hong Kong airport (https://www.telegraph.co.uk/travel/news/watch-van-crash-into-plane-as-it-prepares-for-take-off/).

Statistics of such incidents (Alomar and Tolujevs, 2017; Wilke et al., 2014; Calle-Alonso et al., 2019; Price & Forrest, 2016 Statistical summary of commercial jet airplane accidents: Worldwide operations 1959–2016, 2017; The information from an investigation conducted by the Interstate Aviation Committee, 2021; Shvetsova and Shvetsov, 2020; Barrado et al., 2020; Shvetsova and Shvetsov, 2021; Pérez-Castán et al., 2019; Huttunen, 2019; Davies et al., 2021) shows the need to develop and implement additional means of monitoring the operation of the airport's technological transport.

2. Methods and results

Based on the fact that the technological transport of the airport, as a rule, is represented by motor vehicles (MV), it is advisable to consider the possibility of using controls used in other areas of land transport on such MVs.

Currently, the maximum requirements for equipping with controls are imposed on passenger vehicles, as well as vehicles carrying dangerous goods. A mandatory additional means of control, which should be equipped with such vehicles, according to both Russian and international regulations, is the tachograph (Fig. 3).

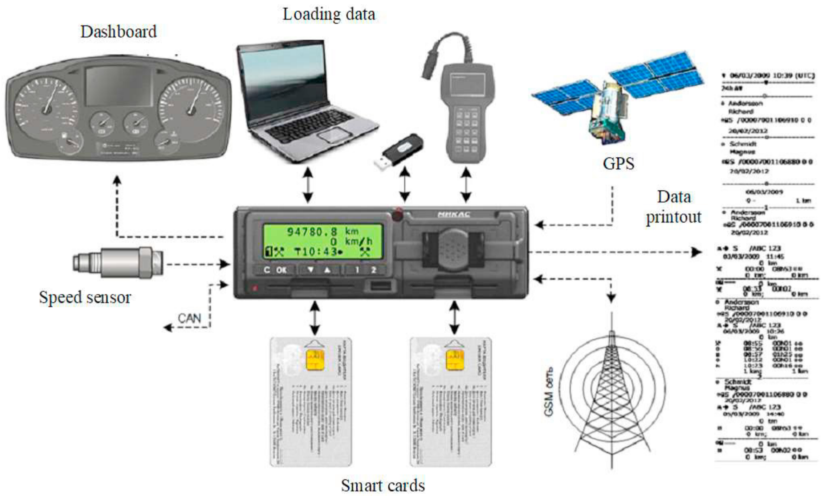

Fig. 3. How the tachograph works (https://auto-tahograf.ru/tahograf/takhograf-mikas/takhograf-mikas-s-skzi/).

A modern digital tachograph is a complex technical system. The main task of this device is to comply with the established operating modes of the vehicle, such as speed, duration of the driver's working time, etc.

The impact of the use of the tachograph on increasing the controllability of the airport's technological transport modes is analyzed in Table 1.

Table 1. The effect of switching on the tachograph on increasing the controllability of the modes of operation of the technological transport of the airport.

Main risk factors for an accident	Identification/blocking of the factor under consideration when using a tachograph
Driver fatigue caused by exceeding the permissible operating time	+
Dangerous rapprochement with other vehicles	-
Alcohol intoxication of the driver	+ (when adding an autonomous car breathalyzer to the complex_

In addition, the impact of each of the factors on the development of the risk of an emergency situation was assessed.

The assessment was carried out by expert assessments with the participation of 7 traffic safety specialists.

Step 1. Creation of a specialist commission and determination of the factors under consideration (number of specialists m = 7, number of factors n = 3).

Step 2. Conducting an expert assessment of the factors under consideration (Table 2).

Table 2. The result of the specialist assessment of the factors under consideration.

Factors	Specialists						
	1	2	3	4	5	6	7
Driver fatigue	0.1	0.5	0.1	0.4	0.3	0.1	0.3
Dangerous rapprochement with other vehicles	0.7	0.4	0.5	0.3	0.4	0.3	0.4

Alcohol intoxication of the driver	0.8	0.6	0.7	0.5	0.6	0.5	0.8

Step 3. Processing of specialist evaluation data.
Formation of the table of ranks (Table 3).

Table 3. Ranks.

Factors	Specialists							Ranks	Deviation from the average amount of ranks	Squares of deviations of rank sums
	1	2	3	4	5	6	7			
Driver fatigue	1	2	1	2	1	1	1	9	-5	25
Dangerous rapprochement with other vehicles	2	1	2	1	2	2	2	12	-2	4
Alcohol intoxication of the driver	3	3	3	3	3	3	3	21	7	49
Sum										78

Step 4. Assessment of the consistency of specialist assessments on Kendal Concordance coefficient

$$W = \frac{12S}{m^2(n^3-n)} = 0.796, \quad (1)$$

where S = 78, n = 3, m = 7.

W = 0.796 indicates a sufficient degree of consistency among specialists.

The obtained result of the specialist assessment of the factors under consideration is shown in Table 4.

Table 4. In the development of the considered factors on the risk of an emergency situation (with a total sum of values = 1).

Factors	Set factor value
Driver fatigue	0.17
Dangerous rapprochement with other vehicles	0.26
Alcohol intoxication of the driver	0.57

3. Conclusion

A modern airport is a complex technical system in which air and ground transport interact. The accident-free nature of such interaction is one of the decisive factors in determining the effectiveness of the airport as a system.

The article analyzes ways to reduce accidents at airports, and with the interaction of various modes of transport, it is established that at the moment one of these ways is the introduction of an additional means of control - a digital tachograph. It is established that the introduction of this control can reduce the risk of an accident involving technological vehicles of the airport

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