Resolution Christmas Riddle 2017

Thank you, dear friends of our annual Christmas Riddle, for the active participation in this year's question, which left a lot of space for professional discussions.

Important facts for the approximation can be determined by internet research or simple estimation: the number of aircraft movements, the types of aircraft and weight classes, tire sizes and number of wheels per aircraft type, etc. Fraport AG's 80-page air traffic statistics 2016 offer a sheer immeasurable wealth of data that can be used for the calculations. An important piece of information is also that aircraft tires are retreaded today and endure about 200 to 300 landings. However, one factor of uncertainty remains: how much rubber is actually transferred when landing, for example, when the tires are accelerated from zero to 250 km/h in fractions of a second, the landing speed of an Airbus A 330-200. We only perceive the cloud of smoke and, over time, the significant increase in abrasion on the runway.

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This surface leads to an ever less grippy surface. Especially in the rain, the runway is then very slippery, and the landing becomes more and more dangerous. The condition of the runways is therefore regularly checked and, if

necessary, cleaned by specialized companies with special machines. At Frankfurt Airport, this happens at least four times a year during the night, when there is no flight operations.

This is where our solution approach comes in. The waste report from Fraport AG also documents the quantities produced, broken down into different types of waste. Among other things, it lists around 100 tonnes of rubber debris that is milled and collected from the runways using special high-pressure water cleaners. The result is first a mud mixture, which is then processed and afterwards disposed of.

With 462,885 aircraft movements in 2016 (arrivals and departures) and the assumption that most of the rubber will be transferred to the runway at the time of landing, an average of 400 grams of rubber will be left at the airport per landing.

A very respectable amount, as we find.

A great tribological calculation approach was demonstrated by our colleagues from the Fraunhofer Institute for Material Mechanics in Freiburg, which is an impressive proof that with profound expertise the right answer can always be found.

Dr. Tillwich GmbH
Werner Stehr

Lösung Weihnachtsrätsel 2017

Fraunhofer IWM

Gesamtabrieb der Reifen		
Druchmesser max	1.2	m
Profiltiefe max	5.0E-03	m
Druchmesser min	1.2	m
Breite	0.5	m
Anzahl der Räder	10.0	
Volumen	9.4E-02	m^3/Reifen
Dichte	1250.0	kg/m^3
Masse Abrieb	117.3	kg/Flugzeug
Landungen	229950.0	Landungen/Jahr
Anzahl der Landungen	250.0	Landungen/Reifen
Anzahl der Reifen	919.8	Reifen Pro Jahr
Gesamtabrieb der Reifen pro Jahr	**107910**	**kg/Jahr**

Anzahl der Landungen		
Landungen	35	Landungen/h
Flugbetrieb	18	h
Landungen pro Tag	630	
Landungen im Jahr	229950	

Abrieb auf der Fahrbahn		
Breite	0.3	m
Länge	1.2	m
Dicke	1.0E-04	m
Volumen	3.6E-05	m^3
Anzahl der Räder	10.0	
Dichte	1250.0	kg/m^3
Abrieb /Landung	0.5	kg/Landung
Abrieb im Jahr auf der Fahrbahn	**103478**	**kg/Jahr**

ca. 96 % Des Abrieb bleibt auf der Fahrbahn
--> Der Rest landet als Feinstaub in der Luft