THE LEGAL STANDARDS OF ECOLOGICAL DISPOSAL OF THE LARGE AIRPCRAFTS IN THE WORLD

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This paper presents the results of the analyses the legal standards of ecological disposal of the large aircrafts in the world and in Slovak Republic. By using available information in this paper has performed the analysis of ecological disposal of a large aircrafts in the Slovak Republic and analyse ways of reducing the costs of disposal and recycling aircraft material.

K e y w o r d s: ecological disposal of the large aircraft, legislative standards, recycling airplane parts, PAMELA, AFRA

1 INTRODUCTION

Currently in aviation pays great attention to environmental protection. One of the important problems that must be addressed in this area in the world but also in the Slovak Republic is also environmentally friendly way to dispose of large aircraft. Over the next 20 years to end their service life, or will be taken out of service, more than 14 000 civil airliners. This fact responds Airbus, which launched the project PAMELA[1]. This project focuses on the process of decommissioning airliners out of service, their storage, dismantling and removal, removal of components to manage the processing and recycling of potentially hazardous waste.

Boeing Company, in collaboration with other companies based non-profit association of AFRA[2], which is aimed at destruction of older aircraft fleets around the world. In July 2006, it consisted of 11 companies with a focus to organize and present promising aviation industry through best practices, recommendations and technologies for the management of older aircraft fleet. Ecological disposal of large aircraft, in many countries, especially the former socialist countries, is not yet systematically addressed.

2 ANALYSIS LEGISLATIVE STANDARDS DISPOSAL OF LARGE AIRCRAFT

2.1 Legislation relating to the disposal of large aircrafts on a global scale

Analysis of legislative norms disposal of large aircraft consists of practices and recommendations for disposal of large airliners. In the world of environmental issues deal of EPA[3] and OHSA[4].

Reducing the impact of aviation on the environment is at the heart of the International Civil Aviation Organization (ICAO), which deals with this issue and takes it very seriously. The ICAO Council adopted the strategic objectives of protecting the environment. Through ICAO is concerned with environmental protection committee CAEP. [1]

2.2 Legislation relating to the disposal of large aircrafts in the European Union

European waste legislation creating a regulatory framework in these areas of waste policy:

- batteries and accumulators. Directive of the European Parliament and of the Council 2006/66/EC of 6 September 2006 on batteries and accumulators and waste batteries and accumulators;
- sewage sludge. Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment and in particular the soil, when sewage sludge is used in agriculture;
- packaging and packaging waste. Directive of the European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste;
- burning. Directive of the European Parliament and Council Directive 2000/76/EC of 4 December 2000 on the incineration of waste. [2]

2.3 Legislation relating to the disposal of large aircraft in the Slovak Republic

In the Slovak Republic, Act no. 409/2006 Z.z. Consolidation Act no. 223/2001 Z. z. on waste and amending certain laws, which solves problems in this area. This Act is subject to the Directive of the European Union. At the same time, the creations of the European Directives have been incorporated rules that have been agreed at international level. [3]

[1] PAMELA - **P**rocess for **A**dvanced **M**anagement of **E**nd of **L**ife **A**ircraft

[2] AFRA - **A**ircraft **F**leet **R**ecycling **A**ssociation

[3] EPA - Environment Protection Agency

[4] OHSA - Occupational Safety and Health Administration

3 WAYS ECOLOGICAL LIQUIDATION OF LARGE AIRCRAFTS

3.1 Method of environmental disposal of large aircrafts in the world

Each specialized airline companies liquidates theirs airliners have completed their service life in different ways. The companies, which introduced a system of disposal of aircraft (through various projects), must meet the requirements for the disposal of waste in accordance with these international standards.

The two largest companies in the world, dealing with the destruction of the aircraft company Airbus, which has drawn PAMELA project, through which destroyed a large aircrafts company Boeing, which established Association AFRA dealing with this issue. In the past, airlines Boeing and Airbus compete primarily in the production of aircraft. Currently, their combat moves into the disposal of large aircraft, have exhausted their service life. Both companies compete with each other on which of them will be greener disposed of old aircraft.

Until recently the aircraft have completed their service life, were placed in a junkyard or left to face the desert and local weather conditions. Currently AFRA community includes more than 20 companies that annually recycle more than 150 aircraft.

In July 2005, the company opened Bartin Recycling Group in partnership with Boeing first European recycling factory in France Chateauroux-Deols airport. For this activity also reacted Airbus, which with the SITA waste management and repair company Sogerma, also opened a similar factory in Tarbes in the southwest of the country. These companies compete with each other, which of them will be greener disposed of large aircraft, as demonstrated primarily as a cost effective business. Very serious problem, which is solved on liquidation of large aircraft, is the proportion of recycled material from the original machine. Some companies assume that you can, using current technologies, more than 60% recycled material of large aircraft. Using new technologies dismantling can be recycled up to 90% of the disposed material plane. Airbus predicts that 2015 will be recycled up to 95% of the material from the original machine when using new methods of disposal. The main objective of Airbus and Boeing is the greenest and most economical disposal of large aircraft, have completed their service life. The aviation industry is expected that in the coming years will have completed its technical life of several thousand aircraft, because the issue of ecological disposal is very important. The basic problem now is to create the fastest and most convenient way of recycling. The obtained materials from discarded aircraft, such as iron, nonferrous metals, glass, rubber and many other materials are also used as raw material for the production of intermediate goods, which are used in various industries. [4][5]

Disposal of large aircraft is divided into several phases.

The first phase: the location of the aircraft at a suitable location where it will perform removal and subsequent destruction.

Dismantling and sale of serviceable parts and components, is financially the most profitable stage of liquidation of large aircraft.

Second stage: the disposal of hazardous substances from the aircraft (aviation fuel, oil, hydraulic fluid, etc...) and recycling.

The third phase: the dismantling of aircraft engines and analyzes their situation.

The four phase: dismantling the aircraft avionics systems.

The fifth phase: the dismantling of aircraft interior (seats, windows, doors, insulation materials, etc...).

The sixth phase: elimination chassis.

The seventh phase: dismantling and cutting the wings.

The eighth phase: cutting the fuselage into pieces.

After dismantling of the aircraft to the aircraft broken down by type of material and then passed on for further processing. [6]

3.2 Ecological disposal of large aircraft in the Slovak Republic.

Given the fact that the Slovak Republic has not produced large aircraft, nor does the national air carrier would be required to address this issue, disposal of large aircraft is exercised. In the past, by LOTN as the fulfillment of this task was prepared and drafted disposal system L-410 aircraft of different versions, which have been produced since 1969 over 1100, while their production has been recently restored. [7][8]

LOTN and has built a quality management system certified according to ISO 9001:2008. The European Aviation Safety Agency (EASA) has approved the company as an organization aircraft maintenance and aircraft equipment as required by Regulation (EC) 2042/2003, EASA Part 145

3.2.1 The course of the liquidation of large aircraft type L-410

Discarded aviation technology discusses the workers involved in the liquidation of the aircraft. Dismantling works are carried out in compliance with the safety rules with procedures to prevent damage or destruction of dismantled parts and assemblies.

In preparing the aircraft for disassembly is necessary to disable the on-board power sources, reduce the pressure in the aircraft systems and power units to zero, delete the fuel and special fluid. Before handling any aircraft completed its service life and will be conducted on him disassembly process and subsequent destruction shall be disqualified fuel. Fuel is located in the wings of the aircraft and is located in the fuel tank rubber. The fuel tank has a size adapted to the type of aircraft.

Airplane is incapable of moving with towing equipment moved to the place of removal and disposal. The aircraft, which completed its service life and is not able to move, are handled the same way as aircraft in working order, according to the same rules. We have to take into account that the aircraft is not, therefore, its handling and transfer to a suitable space shall be in accordance with the flight manual for the particular type of aircraft. For the movement of aircraft is appropriate to use necessary equipment which is capable to lift the aircraft to the desired height, and those are pneumatic hoists, cranes or hoists. For some large aircraft requires a combination of these devices. [9]
After placing the aircraft to the removal and disposal shall be carried out analysis of the aircraft. Disposal of the aircraft is divided into two phases. During the first phase is removed internal part aircraft and part of the aircraft. Internal forms part of the aircraft cockpit, passenger cabin and cargo space. The external part consists of an aircraft structure, consisting of airframe, propulsion system of the aircraft and aircraft systems.

At the disposal of the aircraft creates an air outlet. According to the Act 409/2006 Z.z. waste is movable object which the holder discards or intends to discard or is in accordance with the Waste Act or special regulations required to discard. Waste is subdivided by different aspects. This includes the separation of the hazardous wastes and other wastes. The waste can be disposed of in various ways, eg.: through recycling, storage, incineration, land filling.

Recycling is defined as a re-appreciation of materials that have previously been used for some purpose and waste originated from them. It can recycle various materials. Materials acquired are used either alone or as an ingredient usually in forming of the key ingredients in order to reduce production costs.

Waste separation and subsequent use of secondary raw materials affects the overall economic cost of disposal of the aircraft. Recycling contributes to the sustainable development of aviation.

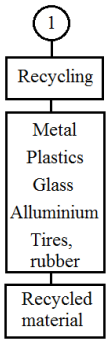

Figure 1 Sorting materials for recycling at disposal of aircraft

Recycling of plastics

Plastics are also part of the design of discarded aircraft. Half of plastic waste in Europe goes to landfill. Green Paper containing the European strategy for tackling plastic waste in the environment, encouraging discussion within the European Union.

In the period from 3.7.2013 to 06.07.2013 were negotiations, which aimed to find out the opinions of this problem and propose solutions. [10]

Recycling plexiglass

Windows in the cabin and cockpit of the aircraft are made of Plexiglas PMMA (Polymethylmethacrylate) called. Acrylic is a hard plastic. Plexiglasses have specific properties, which can include optical properties, aging resistance and UV resistance.

Mechanical recycling of hard plastic on the following scale: collection - identification - sorting - crushing - washing - drying - separation-extrusion or compounding - granulation. [11]
Part of the material, which is obtained from the dismantling and disposal of large aircraft cannot be recycled or disposed of environmentally. Such material shall be placed in landfills. Its location on the landfill must meet the requirements in order to avoid CO_2.

4 ANALYSIS OF ECONOMIC COSTS ECOLOGICAL DISPOSAL OF LARGE AIRCRAFT

4.1 Analysis of the economic costs of ecological liquidation of large aircraft in the world

Based on the economic analysis of environmental disposal of large aircraft, it is possible to describe the financial value of aviation material. Airlines are faced with such material for recycling or removal and subsequent disposal of aircraft. Great emphasis is placed on material that can be used to repair and re-use in aircraft. This material must be in accordance with international standards and certifying procedures. Material must

pass inspections or repairs, in order to be used for aircraft that have not yet completed their service life. On the basis of material obtained from discarded aircraft, the company operating the disposal of aircraft making profits. Such a total include aircraft engines, chassis parts, tires, equipment and avionics equipment operating fluid jet fuel, oil, hydraulic fluid, etc.. For all such parts and materials shall be subject to certification in accordance with EASA. [13]

4.1.1 The engines

The engines are one of the most valuable parts of the aircraft. This section of the aircraft can be sold as a whole or in parts (aggregates). The engine has a value of several million dollars, depending on its condition and residual technical life. The air motor can also rent, resulting in financial income of around 20 000 to 25 000 $ per month.

Recycled board instrumentation come back into the supply chain. Companies engaged in the removal and disposal of the transport aircraft of type Boeing 747, estimated the cost of this activity within 60 000 to 120 000 lbs. This whole process can take up to 12 weeks. Up to 50% of the material on such aircraft can be recycled. The disposal of large aircraft from service occurs, on average, after 24 years of service. The reason for the disposal of large aircraft from its operation may be malfunctioning, wear, or crossing the limits of organic (carbon, high noise level) high operating costs and repair or morally. The engines Boeing 747 aircraft account for 80% of the total value of the aircraft. The engine may be sold off to spare parts and price ranges around around 234,000 pounds ($ 350 000). If the engine is detached with operation inability aircraft is tested and can be mounted into a serviceable aircraft. The financial analysis shows that the engine is sold in parts are more expensive than the engine as a whole. For airline companies is better to buy the engine as a whole, thus saving money that can be used for other purposes.

4.1.2 Chassis

After the engine is the next most valuable part of the aircraft the chassis. Like the engine, the chassis is financially more valuable when sold in parts. Price of the chassis is around thousand dollars.

4.2 Analysis of the economic costs of environmental disposal of large aircraft in the Slovak Republic

The only company that activities associated with the ecological destruction of aircraft engaged as a LOTN, which not only works with LET Aircraft Industries in the overhaul, but also now addresses some minor repair U.S. helicopters.
In LOTN SpA you can focus on dismantling the aircraft type L-410th the resulting value is about this aircraft is € 269,934 excluding VAT. Price is € 323 920.8.

Engine aircraft L-410 M-601B and its market price may be around € 46 000. The financial value of the airframe L-410 is around € 80 000. Price propeller aircraft is € 11 000.

5 COST REDUCTION POTENTIALS FOR ORGANIC LIQUIDATION LARGE AIRCRAFT

5.1 Reducing costs by exchanging

Price calculation disposal of large aircraft will be lower if it will be a large number of such aircraft liquidated in the short term. It is expected that in 2030 the end of the technical life of a large number of aircraft.
If the airlines own specific type of aircraft, for example L-410, there is a possibility of reducing costs when replacing old aircraft with new aircraft of the same type with an additional charge based on the contract between the manufacturer and the customer. This amount is an estimate for the technical documentation and the subsequent expert inspection of the aircraft. Therefore, the exchange rate is not determined but the standard for every contract may be different, because the condition of the aircraft may vary and prices are moving.

The residual value of the aircraft can be determined from the relation:

$$Zai = (VTS - ZO)\frac{1 - qr}{1 - qz}\ (\%)$$

Where:
VTS - baseline aircraft (%),
ZO - the percentage of residual serviceability of the aircraft after the envisaged activities (%),
Q - Share of depreciation for two consecutive years, taking into account the wear and tear airframe = 0,9,
Z - Estimated useful life = 50 years,
r - Working hours = 36 years.

Similarly, it is possible to determine the residual value of the engine. Assuming that the overhaul of the engine due to its variant M 601B will perform, will assume technical recurs for technical life. The engine M 601B can be purchased at the market price of € 46 000. Engine exhausted 25% of its contemporary value. To determine the residual value of the motor is assumed that the engine runs more contemporary than recurs hour (for two years of operation ran out the clock 7% and 25% contemporary recurs).
Then the value of the left engine is:
TVLE = 46 000.0.75 = € 34 500

Where:
TVLE - Technical value of the left engine.

In the same way it is possible to establish the technical value of the left propeller. Technical propeller life is not fixed, and therefore the value of the propeller is based on the value of a real overhaul of contemporary recurs observed propeller.
The estimated cost of the overhaul is € 16 400.
The value of the left propeller is:
TVLP = 16400.0,69 = € 11 316
Unused contemporary recurs propeller is 69%
Where:
TVLP - Technical value of the left propeller.

5.2 Reduction of labor costs

For ecological disposal of large aircraft can reduce costs by reducing the number of workers. The lower number of more comprehensive, professionally trained staff can replace a greater number of highly specialized workers.
In Table 1 is performed financial analysis of the costs of labor resources at disposal of the aircraft on which it will participate in 10 workers. These workers will be working 8 hours per shift. Disposal will take 10 working days, which ultimately means that workers have worked 800 Nh. Standard hour is determined by the average wage in the national economy, the Slovak Republic in 2012. Amount per man-hour is determined by a contractual relationship between the sponsor and implementer. The resulting amount is € 4 368, which gets 10 workers for 800 Nh.

Table 1 Analysis of labor costs for disposal of large aircraft L-410

Worker	Number of workers	Nh/10 Work days	Suma	The resulting financial costs calculated on the average hourly wage 5,46 €/h
Specialist in engines	1	80	**436,8**	
Mechanic	3	240	**1310,4**	
Upholsterers	1	80	**436,8**	
Specialist in radio	1	80	**436,8**	
Specialist in electricity	2	160	**873,6**	
Specialist in equipment	1	80	**436,8**	
Specialist in windows	1	80	**436,8**	
Suma	**10**	**800**	**4368**	

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