

Business options for aircraft recycling

About 25% of the current civilian aircraft fleet will be decommissioned in the next 15 years, creating a potential of approximately half a million tonnes of valuable materials and a multi-million Euro business. *Professor Joerg Woidasky, Peter Saile and Sebastian Jeanvré* report on a unique recycling challenge.

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IN THE emerging field of aircraft recycling, numerous business and technological challenges lie ahead. This includes materials identification, drainage and detoxification, materials flow and materials recycling options for those materials that are currently being disposed of.

In the years to come, 400 to 450 airliners (narrow and wide body) from commercial aviation will be decommissioned annually, plus regional, military and general aviation aircraft.

About 13,000 aircraft are expected to be retired in the coming decades. The aircraft retirement age up until now has been anything from 20 to 30 years, but in some cases (for economic reasons) it is dropping, even to only a few years.

On the other hand, by refurbishing the aircraft after 10,000 to 15,000 flight cycles the aircraft service life can be extended by a considerable amount. The decision is being made on a case-to-case basis, making economic assessment of the residual value of the aircraft and its technological status the key step for dismantlers and recyclers.

End-of-life operations, waste management, and recycling

Materials recycling on its own does not pay for the end-of-life aircraft (EoL AC) activities alone. Focusing on the materials revenues for structural and other materials, typically not more than €100,000 per aircraft can be expected, depending mostly on the mass of the obsolete AC.

Thus to create a robust business case, parts re-use is a necessity. Technically speaking, these end-of-life operations become comparable to heavy maintenance operations.

Moreover, similar regulations for handling and checking the aircraft parts apply. In terms of the waste management regulation, this is being identified as 're-use', i.e. operations by which products or components that are not considered to be waste are used again for the same purpose for which they were conceived.

In the European Union's waste hierarchy, the 'preparation for re-use' covering checking, cleaning, or repairing operations - by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing - is second only to waste prevention.

Once the product is finally being discarded, further to the EU waste directive [EU 2008], this renders it to be 'waste'.

When it comes to 'recycling', any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes is being addressed, except for energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

As a consequence, targeting a sustainable solution for dealing with EoL ACs, the entire range from re-use operations to recycling and disposal steps has to be covered by an

integrated EoL AC management concept. The step from the aircraft parked under specific aeronautic regulations to discarding the product and entering the waste management sphere is of paramount importance regarding the business implications.

In EoL AC management, both the aeronautical and the waste management sphere have to be mastered.

The PAMELA (Process for Advanced Management of End-of-Life Aircraft) project has set standards and not only for this procedure. The challenge is to develop a cradle to grave concept for the entire EoL process for obsolete AC. It is very important that all trades cooperate. The parts value is very high whereas the materials value of the extracted secondary raw material is little in proportion to the total EoL AC residual value.

End-of-life aircraft approaches and businesses

Taking a look at the stakeholder's policies and networks reveals two approaches.

Airbus is involved in the TARMAC Aerosave operations, which initially originated from the PAMELA project, being supported by a grant from the EU-Life Program.

Its results were used as a basis for the Tarbes-based operations along with SITA France and additional partners, now offering the potential of dismantling up to 30 airliners annually, and currently being extended with a storage space for 250 aircraft in Teruel/Spain.

According to Airbus, TARMAC will be in the position to absorb the entire EoL ACs generated in Europe. More than 100 aircraft have been accepted here so far.

A network approach is being followed by the Aircraft Fleet Recycling Association (AFRA) which was founded in 2005.

Both Boeing and Embraer are AFRA members. This non-profit association has issued a best management practices guide and on this basis provides for accreditation of its member services for disassembly and

recycling. As of today, AFRA members have dismantled more than 7,000 commercial and about 2,000 military end-of-life aircraft.

A relevant share of the AFRA members are small or medium-sized enterprises, many of those from the maintenance, repair, overhaul (MRO) sector, or from the waste management sector, respectively, located mainly in the US or Europe (especially the UK).

Both Europe (25 companies) and North America (32 companies) are the most important locations for the stakeholders, whereas both Asia and Africa do not play an important role here.

Within Europe, the companies' accumulation in the UK (11 companies) is remarkable, whereas in France (four companies) and Germany, the Netherlands and in Luxemburg (two companies each) there are only few companies working in this field.

To highlight one example, the German companies Keske, Stute, Süderelbe and Clausthal Technical University have developed and are currently operating a mobile approach.

The project - which received a grant from the German Federal Ministry of Education and Research (BMBF) - is named MORE AERO. The MORE AERO unit consists of tank containers and the equipment comprising hazardous materials. Additionally, a cutter and grabs to pre-crush the AC at every place at the world are contained in the mobile unit placed in standard shipping containers.

Development perspectives

Regarding the design of aircraft, optimisation of the use phase especially for fuel efficiency and noise abatement ('green operations') is without a doubt the most relevant issue, as the environmental impact of the 'use' phase overrides by far all other effects of other aircraft life cycle phases.

Nonetheless aircraft, especially airliners, seem to be attractive objects for disassembly and recycling. Aircraft disassembly and

recycling currently is an emerging field, triggered by shorter aircraft life cycles, demand for raw materials in developed countries and the growing concerns about materials supply.

Aircraft assemblies might be re-used, and the remaining structure consists of high value alloys that are recyclable, typically beyond 50 metric tonnes per airliner. Assemblies and parts for re-use are being handled under the EASA part 145 rules both for aircraft in service and end-of-life products, using structures that are in place, and relying on stakeholders already in the market. The downside of the business field is the low total number of aircraft sent to recycling annually.

Moreover, they are not located in specific sites, and recycling processes are few. Market structures for end-of-life aircraft are developing slowly, along with recycling options for specific aircraft materials. For material recycling, high value recovery and processing options have to be opened, potentially combining material streams. Starting with mapping and identification steps, separation, and recycling for metals, polymers and composites have to be explored; particularly composite materials from the interior which are still a challenge for recycling.

Adequate disposal solutions

Although under discussion for almost a decade, end-of-life aircraft business has only recently raised higher awareness.

It is not yet clear whether only a small number of centralised sites and companies or a decentralised network of smaller stakeholders will provide for the long term recycling and disposal structure.

Perhaps a combination of both could be a probable outcome? In any case, aircraft business and disposal business adequate solutions will become necessary, i.e. to prevent bogus parts generation and to ensure a high product quality as well as make sure environmental protection standards are continuing to be met.

