

solvents in action, Spring 2006

It is very much taken for granted these days that you can step onto an airplane and get off again after several hours in a country thousands of kilometres away. Only very few people think about, or realise, the enormous amount of technological innovation and people skills that go into building, flying and maintaining safe and reliable aircraft. Only by implementing the most stringent technical standards on both the production and maintenance of aircraft has the aviation industry managed to achieve what is considered to be the safest and most efficient mode of travel. Solvents, like many other chemicals, play an important role in this process.

The role of solvents

Solvents are used in both the manufacture and maintenance of aircraft and they are also a key component in the production of the raw materials that are required. Not only do solvents help manufacturers create lighter, safer and more efficient aircraft, they also help ensure that these aircraft remain safe during their many years of operation. The following overview provides a small and non-exhaustive insight into the many applications where solvents are required in the aviation industry:

Aircraft manufacturing

Cleaning

Various cleaning operations have to take place at different production stages of an aircraft. The type of solvents required for these tasks largely depend on the type of surface to be cleaned (e.g. metals, presence of other materials like rubber, etc.), the type of dirt to be cleaned (grease, mineral components, dust, etc.) and the size of the part(s) to be cleaned. The cleaning agent should leave no residue and not adversely

affect metals or other materials they come in contact with. While both solvent-based and water-based formulations may be used, low-toxicity solvents often offer the best compromise between efficiency, optimum product consumption, drying time and safe handling.

Coatings and paints

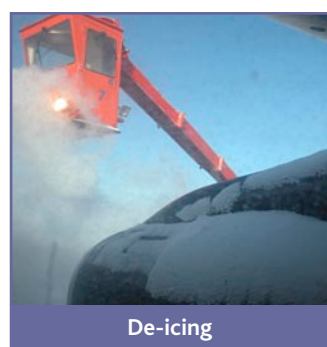
The coatings on an aircraft hull must be extremely durable and must be applied very carefully and evenly to prevent possible inconsistencies, bubbles or cracks. In addition, high-performance paints for aircraft must have a high degree of protection against corrosion, chemical resistance (e.g. to hydraulic fluids, oils, de-icing fluids), long-lasting high gloss and good adhesion. Solvent-based coatings also provide the aircraft with additional protection to high levels of ultraviolet radiation and are flexible enough to withstand possible damage caused by aircraft flexing. Special paints are also required for fluorescent safety signs or to coat electrical wires and other components to provide electrical insulation. Great efforts have been made to develop low-VOC coatings but for certain coating operations, solvent-based formulations offer superior performance.

Composite materials

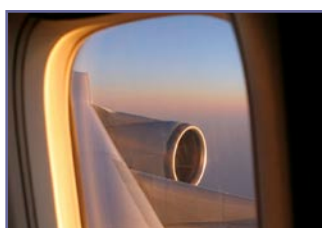
The development of advanced composite materials has allowed aircraft manufacturers to build lighter and stronger aircraft. An added advantage of lighter aircraft is that emissions can be significantly reduced. Solvents are used in the manufacturing of composites, either as part of the resin mixture, as part of the manufacturing process or as a cleaning agent for removing residues from the process / moulding equipment.

Metal working

Aircraft are composed of many metallic parts and low-volatility solvents are an essential component of the cutting or deformation oils which are used in the manufacturing process of these parts. Certain sol-



De-icing



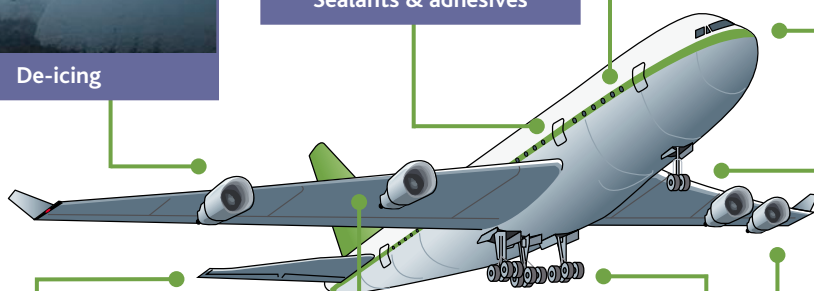
Sealants & adhesives



Cabin cleaning



Durable coatings



Composite materials



Metal working



Crack detection



Landing gear maintenance



General maintenance

vents, non-corrosive and with good lubrication properties, are used as a fluid of choice. They are also used in dielectrical fluids for electro-erosion, dewatering fluids, masking agents for chemical metal working or for temporary rust prevention (between treatments).

Sealants and adhesives

A wide range of sealants and adhesives, which rely on solvents to deliver their specific performance, are required during the production of an aircraft. They are used for applications ranging from installing carpets and interior panels to sealing fuel tanks or fuselage and assembling composite materials to metals, glass and upholstery.

Tyres

Small but critical amounts of solvents are required to ensure adhesion between the different parts / rubbers that compose a tyre. Tyres have to resist significant pressures so flawless manufacturing is essential.

Aircraft operation & maintenance

Cabin

Aircraft interiors are treated with fire retardant chemicals. To clean and disinfect the cabins, one must therefore use specialised solvent-based products that do not interfere with these chemicals.

Crack detection

Aircraft hulls and structures have to endure large amounts of stress and sometimes micro cracks, which are invisible to the human eye, can form. A low surface tension product is required to reveal these micron-size cracks and only certain solvents have the adequate properties to be used in this operation.

De-icing

Aircraft cannot operate safely when ice forms on critical surfaces such as the wings, flaps, rotors or propellers. They must therefore be removed before departure by using de-icing fluids. Specific low-volatility solvents are used in de-icing formulations. Many airports have special drainage systems to collect the de-icing fluids so that they can be used again. Runways also require de-icer to keep them clear and safe during winter operations.

Jet fuel additives

Solvent-based formulations are used to prevent ice build-up in fuel lines and to inhibit bacterial growth in fuel tanks. These additives are primarily used in fuel for military and some private aircraft.



Landing gear

When an aircraft lands, extraordinary pressure is placed on the tyres, suspension and braking system of the aircraft. Disassembling, cleaning and renewed lubrication of critical landing gear components such as ball bearings and seals are therefore crucial to the safe operation of an aircraft. Solvents help ensure effective cleaning of these mechanical parts.

Oxygen

Air filters, air-conditioning units, oxygen lines and tanks must all be cleaned regularly and carefully to ensure that no alien particles or residues are present that could interfere with the proper functioning of the system.



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Case study – reducing VOC emissions

The European aviation sector has spent significant efforts to reduce VOC emissions in line with applicable regulations such as the Solvent Emissions Directive and the IPPC Directive (Integrated Pollution Prevention and Control). Companies have been replacing CFCs and major efforts have also been devoted to, where technically feasible, finding alternatives to chlorinated solvents. The environmental policies of many of these companies aim to minimise the use of solvents to essential uses only.

A good example of these efforts is the VOC reduction guide (*"Schéma de maîtrise des émissions de COV dans les industries aéronautiques et spatiales"*) which was developed by aerospace companies such as Airbus in cooperation with specialised institutes and the French authorities.

The guide, which is available for free on the internet, highlights numerous best practices. These include practical and simple operating procedures that can be implemented in factories and which can lead to a considerable reduction of VOC emissions and solvent vapour concentrations.

Other highlighted procedures include:

- Introducing the use of wipes which have been pre-impregnated with low-hazard solvents for cleaning small parts. The wipes ensure an optimal use of solvents, eliminate risk of spills and reduce exposure.
- Introducing catch-pans and trolleys which can be installed under solvent bottles/containers to prevent spills. They should be located and stored in special ventilated areas to reduce exposure, contain only the solvent quantity required for daily use and can be equipped with a fire-protection system.