Freight Transport by Autonomous Heavy Carrying Dirigible (AHCD)

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Freight transport challenges

Several European States invite to develop new transport technologies to satisfy industry demands concerning heavy components transportation, to unblock road and rail networks close to asphyxiation, to find air transport means alternative to planes allowing to clear air terminals, to preserve environment by decreasing harmful effects, to transport freight without requiring expensive infrastructures detrimental to communities and environment, to satisfy the increasing needs of public safety and security and to comply with ratified principles on sustainable development.

A type of dirigible designed for freight transport would allow facing this challenge. The success of aeronautics, more rapid and more efficient for men transportation, induced the end of big dirigibles. Freight transport was not a problem at this time when the greatest part of trade was confined to the West. Ships, and planes for emergencies, were sufficient throughout the second part of the last century. Nowadays, transcontinental and intercontinental trade reach such levels, as there is no more appropriate response today.

Advantages of dirigibles

The main advantage of dirigibles, from the moment when past scientific data are updated owing to more than 50 years of aeronautics and space evolution, is autonomous transport without any need of an important specific infrastructure.

New types of Autonomous Heavy Carrying Dirigibles (AHCD), owing to the last aerospace technologies, will soon allow transfers from origin to destination freed of land transport infrastructures. So, these dirigibles interest particularly enclosed countries with huge areas and a low density of land infrastructures, because they allow other ways of planning road infrastructures needs, giving priority to road links between logistic terminals and places of goods producing and marketing.

AHCDs allow indeed facing really to take up the challenge of alternative transport to long distance road transport that requires creation of infrastructures expensive to carry out and to maintain. They allow too bringing a relevant answer at once to supervision (traffic, forest fires, coasts, etc.) and to freight transport, while keeping with a reliable, clean, safe, relevant and sustainable intermodal transport.

They are also capable of supplying additional service useful to sea transport, taking over big ports to serve their continental hinterland… They can actually supply ports with a means of rapid lifting for freight unloaded from ships and of direct delivery to the client independently of road infrastructure arriving, and take part in that way in clearing port facilities, reducing as

much the continuous flow of trucks. Their amphibian nature may open freight market to some harbours with limited infrastructure.

They can moreover set up new logistics service to modern industry, as an essential tool in exchanges globalisation allowing industrial door-to-door (component parts and manufactured products), empowering from now on rapid, safe, precise transport of heavy or big size loads, independently of any prior infrastructure (North Canada, Siberia, China or developing countries). They can allow exploitation of oil resources in sites out-of-the-way by any other transport means.

Their stationary flight abilities allow them lastly to be commissioned for observation, salvage and rescue operations (prevention against fires, coastal watch, cleaning out locating, etc.).

AHCDs application fields in freight transport

AHCDs can actually answer to transport needs of:

- Intercontinental freight, with an average speed of 160 km/h and an excellent cost-delay offer, between plane and ship.
- Long distance continental freight, getting rid of bulk breaking due to borders or to land transport infrastructure disparities.
- International freight requiring by land many border crossings with ticklish customs and administrative procedures.
- Long distance moving of cars and other vehicles, retailing and distribution industry products, materials, raw loose goods, containers.
- Goods and equipments towards enclosed countries or countries without safe land transport infrastructures.
- Short distance moving, to bypass or to jump over obstacles: mountains, marshy deltas, frozen gulfs (gulfs of Finland, Botnia, etc.), ways blockaded by snow, rain, fire, landslides, congested areas.
- Heavy components that cannot be moved by road or rail (aeronautics, aerospace, railway equipments, energy, heavy industry).
- Equipments of civil defence, emergency or humanitarian aid for operating in case of natural disasters (earthquakes, tidal waves, eruptions, floods, etc.).
- Reconstruction equipments and materials after conflicts or disasters.
- On inaccessible sites by any other transport means excepted helicopter.

Though being somewhat apart from freight transport, the point "civil defence" of AHCDs is particularly important, for, beyond observation missions, the AHCDs can operate themselves in the struggle against forest fires if used as air tankers. But it is mainly in **emergency humanitarian transport** that AHCDs are particularly efficient.

In crisis, war or natural disaster events, the exceptional circumstances make approach difficult to the accurate places where humanitarian aid is needed. It is dangerous and really too slow. These tragic events generally require rapid, urgent responses, and the standard conveying modes of aids by land or air routes are often inappropriate, and even simply impassable or too dangerous.

The dirigible is the ideal means to rescue populations in great distress. The advantage of the dirigible is actually that it does not requires airports to land, airports often controlled by adverse forces in the case of conflicts or inaccessible in the case of natural disasters. In an emergency and rescue background, it can carry and bring exactly where the need is, in any place in the world, first-aid food and equipment. It can bring an entire hospital and move quickly populations in danger.

Types of goods concerned

All types of goods are concerned by transport in AHCD, but particularly:

- Cars and other vehicles, for instance to connect manufacture plants to faraway market areas.
- Wholesale manufactured products.
- Bulk and raw materials in large amounts.
- Containers and intermodal loading units.
- Industry heavy components (aeronautics, aerospace, energy production, …).
- Humanitarian freight: what may represent 250 T of humanitarian freight? In the store room, on a first level, 150 T representing for instance 10 off-road ambulances (25 T), 25 T of medicine or food, 100 T of rescue equipment (tents, blankets, water treatment equipment, fuel for vehicles, human means, up to 200 persons and more), etc. On a second level: 100 T constituting a complete air-conditioned and secure field hospital with more than 100 beds, 2 surgery operating rooms, resuscitation, radio equipment, scanner, etc. Intervention time depending on distances would be from 1 to 2 days with several AHCD units distributed around the world.
- Building materials, especially bulk (cement, sand), but also prefabricated carcass (prestressed beams, slabs, panels, timber or glue-laminated framework elements) and finishes elements, or also whole prefabricated buildings.
- Facilities components.
- Agricultural and fresh produce from distant areas, especially in some African countries.
- Food (rapid delivery, especially of fruit and vegetables, without need setting up a refrigeration chain).
- Water, let it be for communities supply, tanks filling, irrigation or struggle against fires. And, beyond water, various other kinds of liquids.
- Spread treatments to contend parasites, insects, for mosquito-control or to improve soils for agricultural purposes and protect cultivation, for which AHCD can operate directly as spreader
- And, as for all, carry military equipments.

Aerospace Adour Technology "First" project

Current technologies allow solving problems that lead to the death of the big dirigibles of inter-war years.

Helium blown up, modern anti-lightning textile wrapped, compressed air ballasted like submarines, detachable nacelles equipped, these new dirigibles allow carrying capacity of 250

t at 160 km/h, with a flight autonomy between 6 000 et 10 000 km, at a flight altitude of 2 000 m, and mooring practically in any place in any circumstances.

The current projects should be operational for tests in 2007 – 2009, and brought into commercial service for small 30 t dirigibles for watch and tourism around 2009 and 250 t heavy carrying dirigible for freight in the period 2010 – 2015.

Suited to long distances (9.000 km at an average of 160 km/h), "First" is the first dirigible gaining a real autonomy. It is based on a revolutionary ballasting concept by compressed air, internationally patented, including in the United States and in Canada. Its gondola is detachable, amphibian, autonomous (slow shifting of the gondola on air cushion from two turbines, front and rear) and of big size (60 m long, 14 m wide and 8 m high).

This project is studied in France in the scope of a very wide scientific partnership, with Pau and Adour Region University (UPPA) and Tarbes technical college (France), Lausanne Federal Polytechnic College (Switzerland), San Sebastian University (Spain), Sophia-Antipolis INRIA (France), French, Belgian, German, Polish, Czech, Rumanian universities, ONERA in Paris, European Space Agency (ESA), a large support of l'Ecole Centrale de Lyon and many other international teams on technological themes more specific.

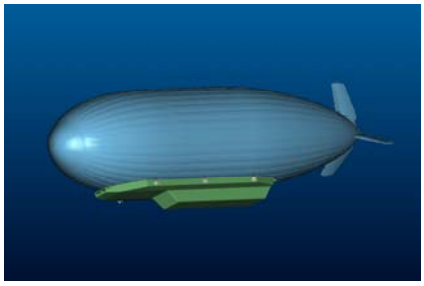
The industrial partnership is also rather large: CEMA / SN RIOUT (Shareholder, France), for global engineering and aeronautic architecture, Air Liquide (France) for helium conditioning, reprocessing and filtering, GDTech (member of the group EWA from Belgian aeronautics), CLUBTEX Textiles du Nord, for textiles development and manufacture, former partners Cargolifter (Germany), European Airships Engineering (Netherlands), Airborne Development (Netherlands), Flow Motion (Netherlands). Development conventions have been reached with DGP Thermoplan (Russia), Shanghai Vantage (China) and, under discussion, Antonov (Ukraine), Renault - Nissan (France - Japan), Zeppelin (Germany).

The industrial project schedule of the AHCD "First" managed by Aerospace Adour Technologies (AAT) is at the present time:

1°/ 2005/2007: 2 years study programme, having to result in specifications of a 30 T payload marketable demonstrator, and in establishment of a consortium.
2°/ 2007/2009: Construction of the marketable demonstrator (payload of 30 tons)
3°/ 80 tons intermediate AHCD, then de 250 tons payload prototype "First", for the years 2010/2015.

Characteristics of the AHCD "First"

Characteristics of the 250 tons payload AHCD are:



Length: 300 m
Diameter: 73 m
Envelope volume: 900 000 m3
Helium volume: 660 000 m3
Total weight: > 650 tonnes

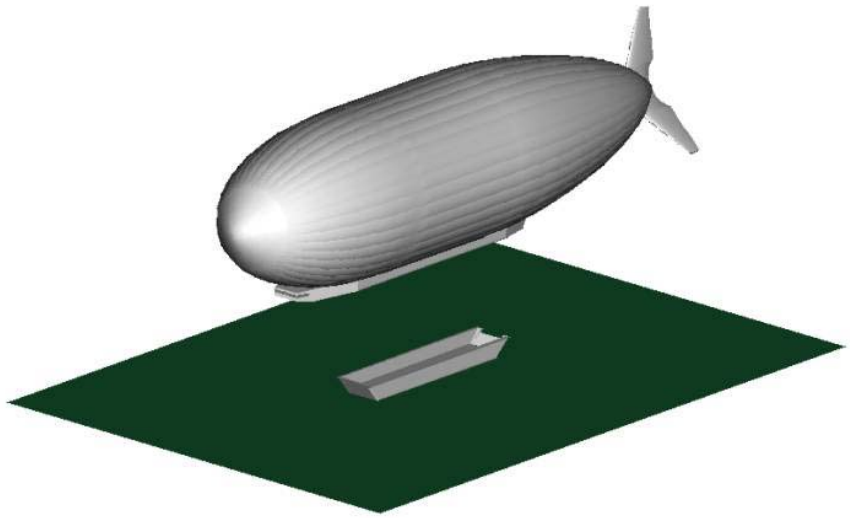
Propulsion: 6 gas turbines of 10,500 HP, that is 36,000 HP
Unloading by growing ballast heavy of 350 T
Gondola: 60 m x 12 m x 8 m, volume around 5760 m3

The lower part is to receive the upper platform of the gondola structure. The fins allow a dynamic and constant control of rolling and nosing up or diving.

An anti-icer system operates by heath exchange with exhaust fumes, reheated air injection by the front and rear parts of the envelope, with a regulation allowing prestressed pressure control on the envelope.

Ballasting operates by compressed air with envelope modular reduction by tension. Torus-shaped air compressed ballasts are located between the extensible internal envelope containing helium and the multilobed external envelope.

While landing, the AHCD is grounded owing to its ballasts. The gondola, once disconnected, let the heavy carrier doing another mission.



Conclusion

Before World War Two, dirigibles offered performances of carriage and range of action distinctly superior to those of the planes of the time, but which still remain nowadays excellent for applications in the field of freight transport. Profiting of more than 50 years of aeronautics and space research, these aptitudes have been clearly improved. The growth of production and of number of countries producing helium offers new technological and commercial opportunities.

Dirigible capacities to verticality gives it an additional advantage that no other transport mode can offer today and that may have conclusive economic consequences in product manufacture and sale logistics.

Its environmental impact (noise, emissions) is far lower than the one of most existing transport modes. Implementation of sophisticated production systems requires every day more abnormal mass transport, so much in weight that in volume, which existing modes cannot satisfy properly and will not be able soon to satisfy any longer. For transport on a world scale, transoceanic or transcontinental, the choice between plane and ship faces too big gaps, as for

prices than for transport time, and a "middle market" could bring dynamism to some concealed economies and offer a new alternative to shippers.

At an altitude of about 2000 metres, dirigibles move sharply underneath cruising altitudes of the usual transport planes that move between 3500 and 7000 metres for turboprop aircrafts and between 9000 and 11000 metres for jets. There is no interference zone with air traffic, for dirigibles traffic will operate out of airports areas.

Investment costs of dirigibles will be around 30 millions Euros for a 30 t and 120 millions for a 250 t, at least in a first time. With only one operation yearly for helium recycling, maintenance costs are by very far lower than those of a plane. Operating and transport costs will take place between plane and ship ones. They are valued by the "Ecole Centrale de Lyon" study between 0,15 € and 0,35 € by t x km depending on operation conditions, that is 5 to 6 times cheaper than plane. The study shows also that variation of dirigibles construction cost has little influence on the t x km price.

The dirigible could thus leave off the field of nostalgic dreams or utopia to meet practically the needs of a freight transport supply, but also of security and assistance to communities, which will lead to increase.