

"Ground effect" Inter-Modal Fast Sea Transport

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ABSTRACT: Energy and emission reduction strategies are extremely important in actual transport situation. "Ground effect" technology recognized from the late sixties has a problem with wide expanding in sea transport. It is connected with stability and control systems, aerodynamics of landing and take off also sea state of civil and military Ground Effect Craft named also WIGs ((Wing in Ground effect) or ekranoplanes Airfoil Development GmbH (AFD) was certified in late 90-ies interesting design of ekranoplane " Airfish 8" by Germanischer Lloyd (+100 A0 WIG – A , WH 0,5/1,5 EXP) like the first civil ekranoplane. The Hoverwing 50 alias WST 500- has successful flown in Korea under AFD licence. Last developments in the aviation field indicates new role in maritime transport of WIG's. Innovations in the fields of aviation improving the performances of WIGs in new future make possible to introduce this idea like "Ground effect" Inter-Modal Fast Sea Transport, which complement other modes of transport and flow of passengers also.

1 GROUND EFFECT TODAY

"Ground effect" is known theoretically from start of aviation thanks to first works by A.E. Raymond or C. Wieselberger and pilots known, that practically does not exist when a plane flies more than one wingspan above the surface of land or sea.

Different civil and military configurations were tested, but the first Ground Effect Craft named Airfish 8 (8 seats) produced by Airfoil Development GmbH (AFD) was certified in late 90-ies by Germanischer Lloyd (+100 A0 WIG – A , WH 0,5/1,5 EXP).

Currently, under license by Korean company Wingship Technology Corp. (WST Corp.) is produced in Singapore like the Hoverwing 50 alias WSH500 (50 seats!).



Source: AFD AirfoilDevelopment GmbH
Figure 1. Flightship 8



Source <http://hoverwing.webs.com/>
Figure 2. WSH 500.

Like was informed in May 2013 WSH-500 is under sea trials in Korean waters and in the process of a full certification by Lloyd's Register UK. Start of the commercial operation in Korean route between ports of Gunsan and Jeju at cruising speed of 180 km/h (maximum speed of 200 km/h) is expected. On European market practically this type of transport is marginally existed in Russia. ATT company introduced new similar civil programme with certified by Aquaglide 5 and 30 seats WIG speed boat see Fig 3 & 4. Also under license from Russia Aquaglide 5 is produced in China like CYD-11 see Fig5



Figure 5. CYG 11

Fleet of ekranoplanes radar-evading named Bavar 2 is used in Iran to patrol its coastal areas beginning from 2010. The design is based on German design X-113 of Alexander Lippish.



Figure 6. Bavar 2

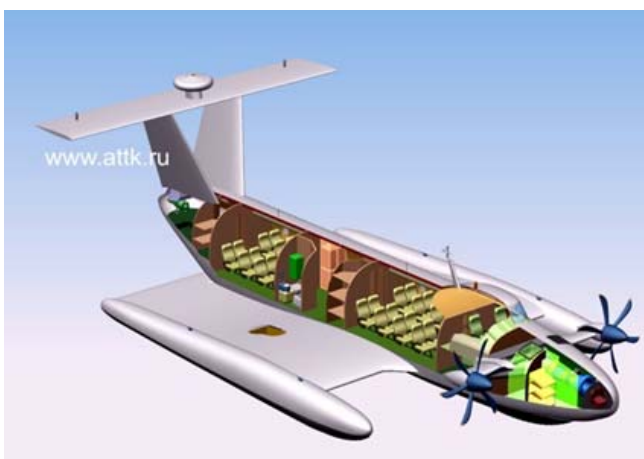


Source: ATTK invest
Figure 3. Aquaglide 5 on Neva (St. Petersburg)

The main parameters of these ekranoplanes are submitted in Table 1:

Table 1

Type of WIG	Fs 8	WSH 500	A5	A30
Dimensions(m),				
L	17,22	29	10,7	22,5
W	15,16	28	5,9	11,3
H	3,35	7	3,4	6,5
Cruising speed (km/h)	160	175	150/170	200
Crew pers.	3	3	1	3
Seats	8	50	4	28
Range (km)	200	300	350/450	700
Wave drag (m)	2.0	2.0	0.35	1.5



Source: ATTK inves
Figure 4. Aquaglide 30

2 INTER-MODAL FAST SEA TRANSPORT

The research concerning the consolidation of maritime and other type of transport is needed to reduce emission reduction and fuel consumption of all type of transport especially in the seas in Europe which has no own reservoirs of crude oil and gas and politically unstable their places of origin like Russia or the Middle East. "Ground effect" transport as initiation of intermodal and international mode of fast travel in area of European seas (Baltic, North Sea, Mediterranean, Adriatic Sea, Black Sea) begin to be discussed and expected, however was not explained on map of Europe on EPATS propositions – see white area of seas on scenario in

2035 for the use of small aircraft in EPATS/SAT below.

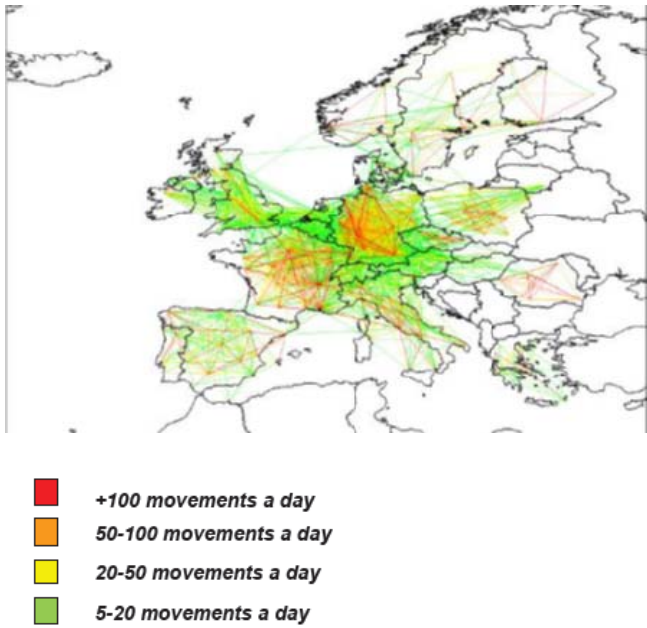


Figure 6 Scenario of small aircraft flight in 2035 by EPATS/SAT RdmP

Acc. preliminary analysis for Baltic sea by AFD Airfoil Development GmbH using WIG technology decreasing of time of trip and cost efficient maritime transport between main ports is expected and reduced in comparison with car or ship. Below in table 2 are shown calculation for route from Rostock to Treleborg on Baltic sea (Fig.7).

Table 2

Type	Car	Ship	Ekranoplane
Time h.min	5.30	2.45	57
Cost Euro	103	36	21

Generally all transport time on European seas will be decreasing in all direction and will be attractive alternative to travel for small distances (based on EPATS < 300km?) in range of max. 350 km/h in existing technologies acc. WIG Page (Fig. *) of all type of business or tourist tours creating better conditions for traveling.

First steps of “ground effect” transport of course must take under care of new customer needs and build new habits and effective competition with other modes of transport.

The introduction of “ground effect” transport will also require innovations in the global economic contex supported by public funds because will be key driver in the cross-country integration in Europe probably firstly on Baltic sea and have strategic importance not only to Europe but to Africa or other continents too.



Figure 7. Routes of ekranoplane by Fischer Flugmechanik und AFD Airfoil Development GmbH

Required power for different transport modes

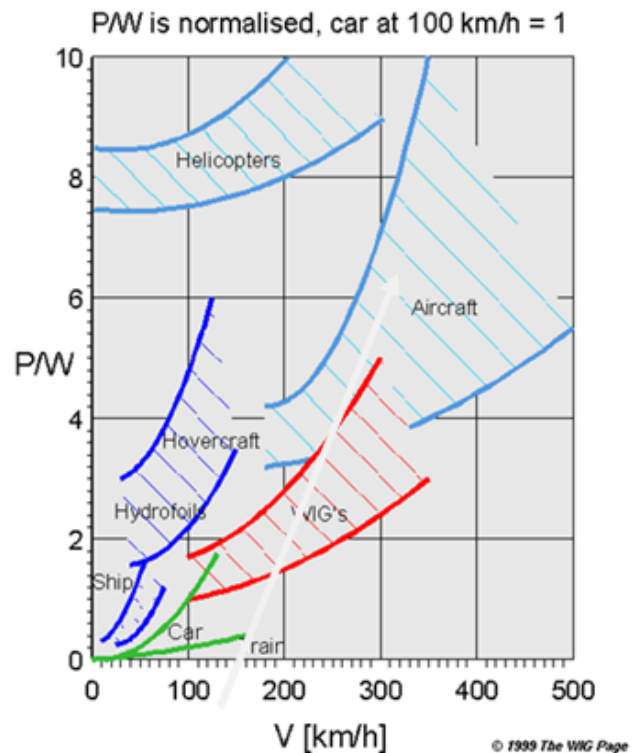


Figure 8 Comparison chart of types of transport

Coincidence with ship routs needs new type of professional pilots/captains, the network of regional seaports including “ground effects” vehicle infrastructure prepared to weather and sea conditions. new type of automated control & guidance, IFR operations and etc. On long distance between Europe and America will be very interesting idea of “floating airports” as a emergency port for necessary aircraft repairs and a fuel dock for smaller WIGs.. Like in EPATS two time perspectives 2020 and 2035 in line with ACARE Strategic Research and innovation agenda are good idea. The future of

"Ground effect" Inter-Modal Fast Sea Transport is depending on the consolidation of topical studies on this specific transport and interdisciplinary group of aviation and marine specialists with tourists/business agencies too.



Figure 9 Some "Ground effect" Inter-Modal Fast Sea Transport routes by Fischer Flugmechanik und AFD Airfoil Development GmbH

3 CONCLUSION

Authors concluded that European "Ground Effect" transport infrastructure needs:

- general characteristics and hierarchy list of seaports for intermodal transport
- general requirements for "Ground effect" sea airports
- number of operations, flow of passengers in additional type transport (GA, Business etc.)

- seaports distances and distribution from several points of view (touristic, business, special taxi system etc)
- potential demand for GEIMSEATS and its costs
- confirmed specifications and performance of currently produced "Ground effect" aircrafts
- overview of current R&D efforts conducted
- a vision and future for performances of "Ground effect" aircrafts
- new proposals for adequate research programs at HORIZON 2020, SME Instrument, MED Program in area of aeronautics, aerodynamic design, composite materials, control systems, system of intermodal operations, technology implementation from GA and commercial aviation
- classification of nomenclature and definitions at the EU and national levels, TRL classification of proposal submitted, overview through patent and research connected with WiG aircrafts, submitted in EU registers

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