

Mobile Machines UPDATE

Use HYDAC Expertise
to avoid Air
in Hydraulic Systems



The Problem: Smaller hydraulic tanks are a cause of air in oil

Current requirements for mobile machines

- Emission Standards
- Energy efficiency
- Power density
- Low life cycle cost
- Noise control
- Vibration protection in the workplace



Changes in the machine and hydraulic concepts

Problems of installation space

Consequence: e.g. changes to hydraulic tank:

- Tank volume
- Tank geometry
- Dwell time

RISK:

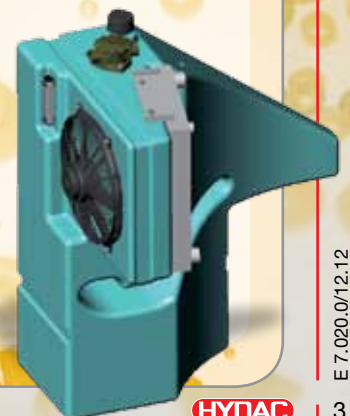
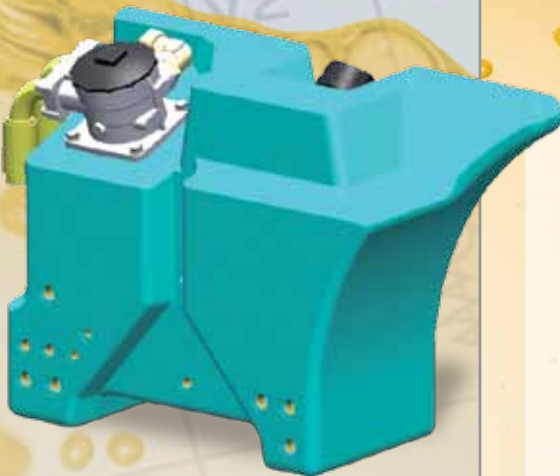


**Performance
problems**

Air in the hydraulic system

Effects of air in the hydraulic system

- Efficiency losses of pumps
- Cavitation damage to components
- Accelerated oil ageing/
Micro-dieseling effect
- Dynamic operating problems/
increased compressibility
- Noise generation
- Increase in temperature

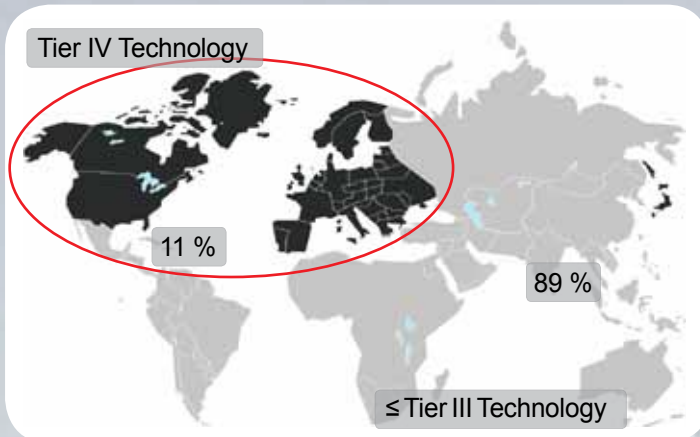


HYDAC

Air in the hydraulic system: the Emission Standards factor

The Directive 97/68/EC to regulate the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machines and equipment (subsequently amended by Directives 01/63/EC, 02/88/EC and 04/26/EC) has direct control over the design of future engine concepts. The increase in space required in the machine as a result of having to install exhaust gas after-treatment systems, together with the inevitable increase in costs for additional components and the increasing demands for energy efficiency, have far-reaching implications for the entire hydraulic system.

As a consequence of the reduced installation space, a high power density will be demanded of hydraulic systems in the future. Against this background, new challenges are being imposed for tank/filter systems in the mobile machinery sector.

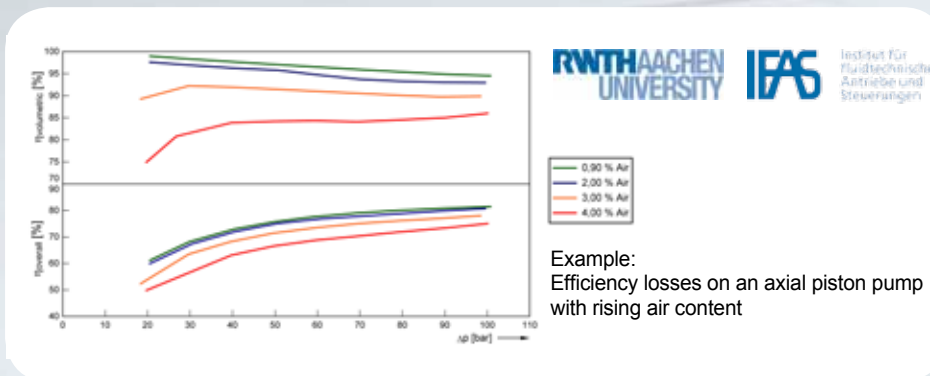


Emissions level and size of the market using the example of hydraulic excavators (16-90 t) Source: Mobile Systems – Markets, Industrial Needs and Technological Trends, Figure 3

Hydraulic oil tanks, including peripheral equipment, have to occupy the minimum space when integrated into the whole machine concept. Better utilization of the available space through the use of complex tank geometries increases, as a consequence, the risk of problems from the **accumulation of air in the hydraulic oil**.

The factors identified here impose great challenges in respect of mobile filter concepts. One of the consequences has been the demand for **additional testing procedures to design filter concepts in accordance with the required application**.

If no measures are taken to optimise the tank/filter design, the repercussions can be drastic:



Increasing space requirement for installation

By the end of 2010:
Tier III / EURO III



- Common rail system
- Single-stage turbocharging
- External EGR (Exhaust Gas Recirculation)

From 2011:
Tier IV Interim / EURO IIIB



- Two-stage turbocharging with intercooler
- Diesel particulate filter

From 2014:
Tier IV Final / EURO IV



- Common rail system
- Externally cooled EGR
- Two-stage turbocharging with intercooler
- SCR system: AdBlue

Development of costs

100 %

+40 %

+25 %

Installation space required

100 %

+40 %

+25 %

Mobile machine update: How to avoid air in the hydraulic syst

1. Engineering

Analysis of the tank/filter system in respect of installation space and integration into the machine.

HYDAC has been dealing with the subject of "air in the hydraulic system" for several years. Sharing and comparing experience with customers, institutes and universities over many years benefits the analysis of a wide variety of hydraulic systems which precedes every project. To achieve the most effective air elimination, it is crucial to study each system individually and in detail for sites of air intake already present and for possible first signs.

Application engineering:

The HYDAC FluidCareCentre, the only one of its kind in the world, is a research and development centre covering an area of over 2400 m². It is equipped with cutting-edge laboratory and testing equipment, making it possible to perform every conceivable filter performance test and fluid analysis.

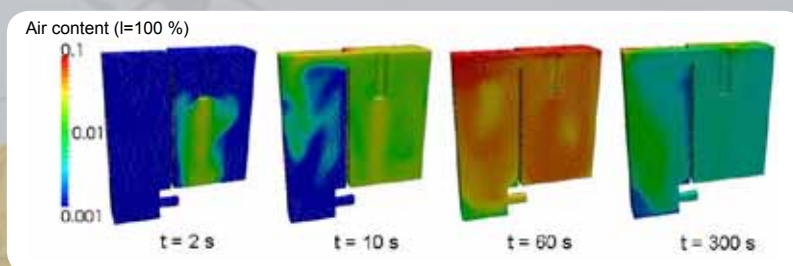
Almost all application situations can be simulated. The number of HYDAC clients whose problems can be traced to air in the hydraulic system is growing steadily. With HYDAC's modern test equipment and advanced knowledge, we are always solving new problems for our customers.

2. Testing / Simulation

Experimental analysis of the tank/filter system on the HYDAC-ART (Air Release Test) test rig.

The HYDAC Air Release Test was developed to satisfy the requirement for optimal integration of the hydraulic filter in tank systems. This test equipment determines the air elimination properties of hydraulic tank systems. The tank under analysis is integrated into the test apparatus as shown in the picture on the right and consists of an open hydraulic circuit with built-in temperature and flow regulation. On the suction side of the circulation pump, a specific amount of air in the form of finely distributed air bubbles can be added to the system. The integrated turbidity sensor determines the concentration of air in the test circuit.

In addition to the experimental investigations on HYDAC test rigs, the air elimination properties can also be determined using transient multiphase bubble flow simulation.



Multiphase bubble flow simulation in the tank

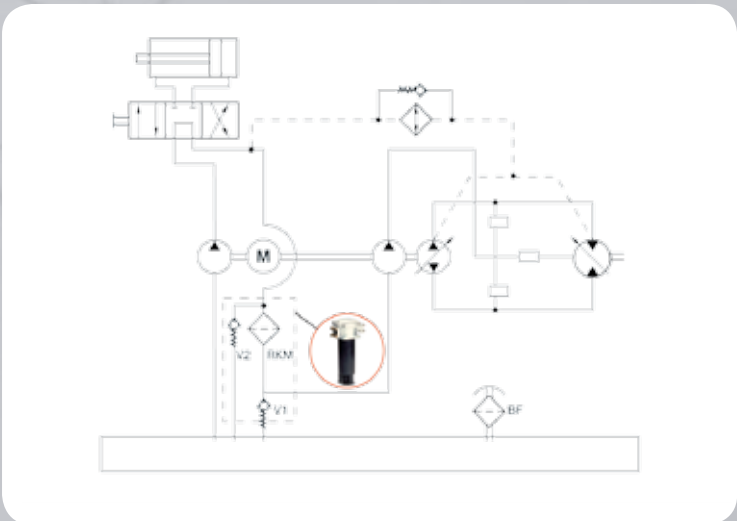
3. Validation

Once a solution has been found, the design is validated at the customer's facility by experienced staff using state-of-the-art test equipment.

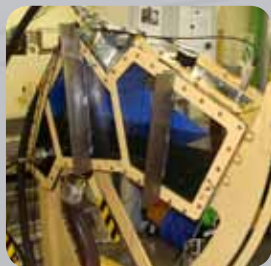
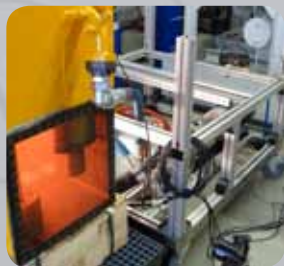
em with HYDAC know-how.



In the FluidCareCenter, 23 experienced fluid technology specialists are engaged on application-specific solutions



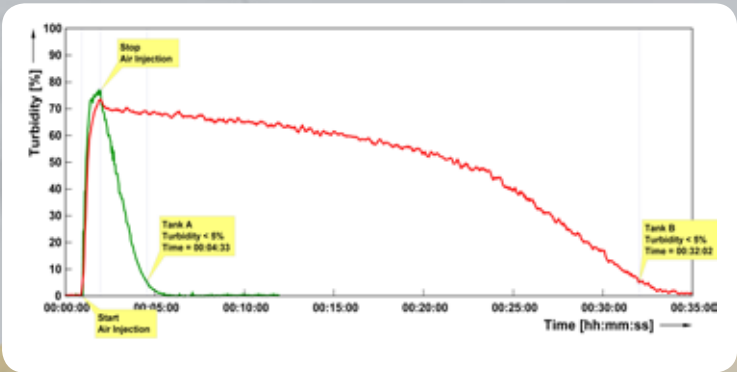
Example of a hydraulic circuit in a mobile machine



Test rig in the FluidCareCenter for designing optimal tank geometry



Examples of the tank systems under analysis



Example of comparison of results from two hydraulic tanks in the ART test rig



HYDAC mobile lab vehicle



In the lab at HYDAC's FluidCareCenter, samples of hydraulic oil can be analysed for air content.

You have come to the right place: HYDAC

In addition to implementing the Emission Standards, the constant stream of new challenges for mobile machines (energy efficiency, power density, life cycle cost, noise protection, vibration protection) requires repeated change in the design of both machine and hydraulics, and the space on mobile machines is already severely limited. In order to utilise the machine installation space to the maximum, the manufacturers of mobile machines revise the tank geometry and try to reduce the tank volume. A constraining factor in these changes is the limited air elimination in the hydraulic tank and the associated risks. HYDAC will support every machine update and will provide the perfect tools for intelligent system optimisation and the early prevention of any problems with air in the hydraulic system.

What can HYDAC offer?

Intelligent system optimisation following individual system analysis and advice on avoiding air in the hydraulic system.

1. Engineering
2. Testing / Simulation
3. Validation

Conclusion:

Throughout the process of revising machine concepts HYDAC will provide you with an individual service which is tailored to the application and will develop the most efficient means of optimising the system for your application. Field tests at the customer's own facility are part of the service and provide validation of the proposed optimum solution.

Checklist



Please detach

Company:

Name:

Machine type:

Position:

Is machine revision imminent
e.g. in the light of the Emissions Directive?

yes ☐
no ☐

Remark

Are there already problems with air
in oil?

yes ☐
no ☐

Remark

Is there a requirement to reduce tank
volume?

yes ☐
no ☐

Remark

Are there problems with oil ageing products
or filter life times?

yes ☐
no ☐

Remark

Do changes have to be made to the
tank geometry?

yes ☐
no ☐

Remark

Have you noticed efficiency losses in the
cooler or pumps?

yes ☐
no ☐

Remark

AIM: AVOID PROBLEMS (by (date):)

AIM: FIX PROBLEMS (by (date):)

Prevention measures:

Remedial measures:

Date / Signature HYDAC and CUSTOMER

HYDAC



Accumulators E 30.000



Filter Technology E 70.000



Process Technology E 77.000



Filter Systems E 79.000



Compact Hydraulics E 53.000



Accessories E 61.000



Electronics E 180.000



Cooling Systems DEF 57.000

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