New microLFA modules for on-line measurement of nutrients in ship of convenience application

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User requirements for an on-line chemical analyzer in a Ferrybox

- Long term unattended autonomy
- Compactness
- Low reagents and sample consumption
- Low life-cycle cost
- Excellent reliability
- Easy interface with data-logger
- Low maintenance by non expert users

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Ferrybox applications with Micromac-1000 analyzers

AWI – BAH
(Biologische Anstalt Helgoland)
2005

MUMM
(Belgica ship)
2011

Micromac-1000 features and limitations in Ferrybox systems

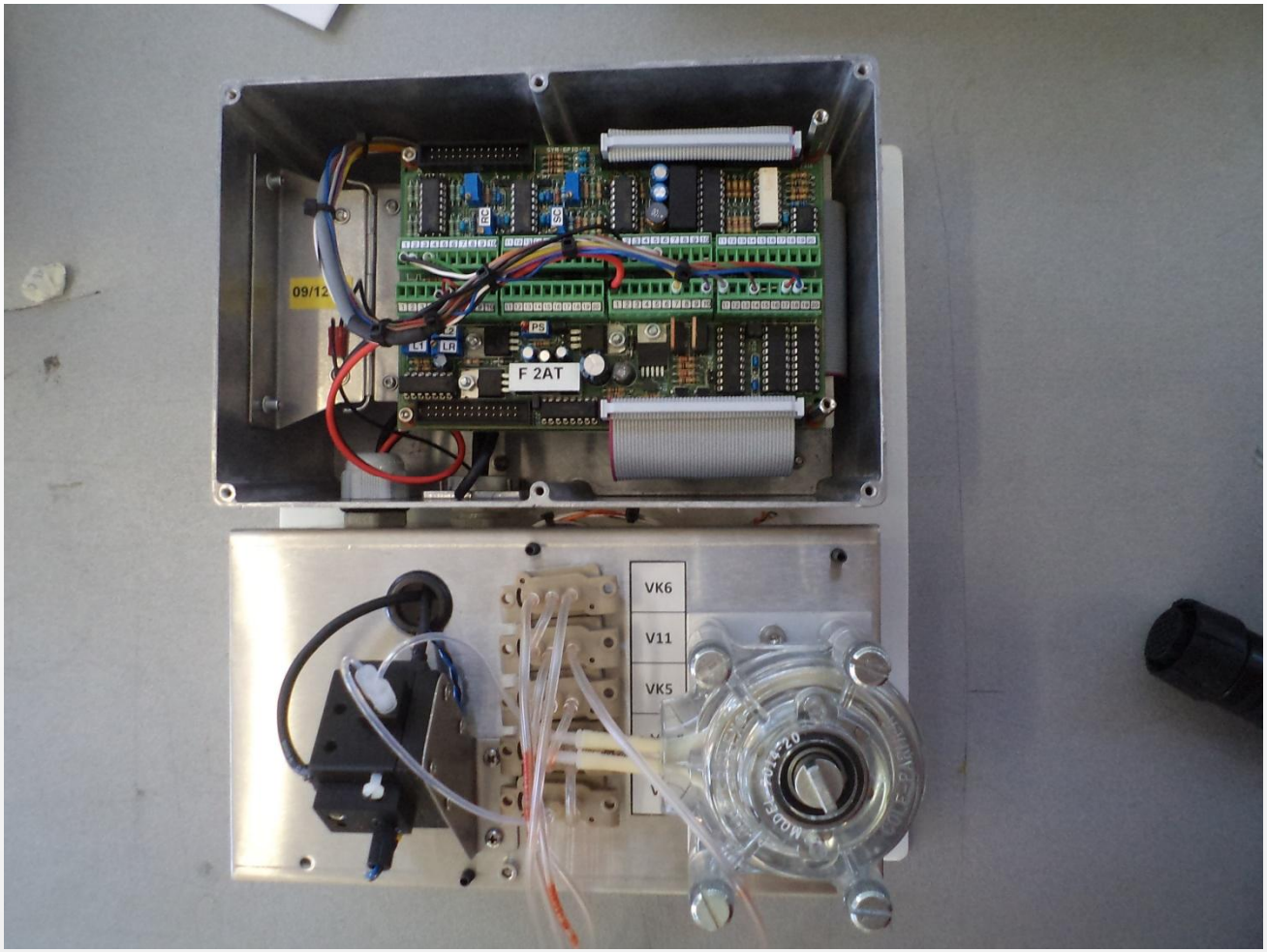
Features:

- Unattended long term use
- Low reagents consumption
- Sensitivity for sea water measurements
- Compactness and portability
- Modularity
- 12 Vdc power supply.

Limitations:

- Silicone based not sealed hydraulics
- Limited internal space for reagents solutions
- Hydraulics not directly visible to the user
- Electronics not sealed.

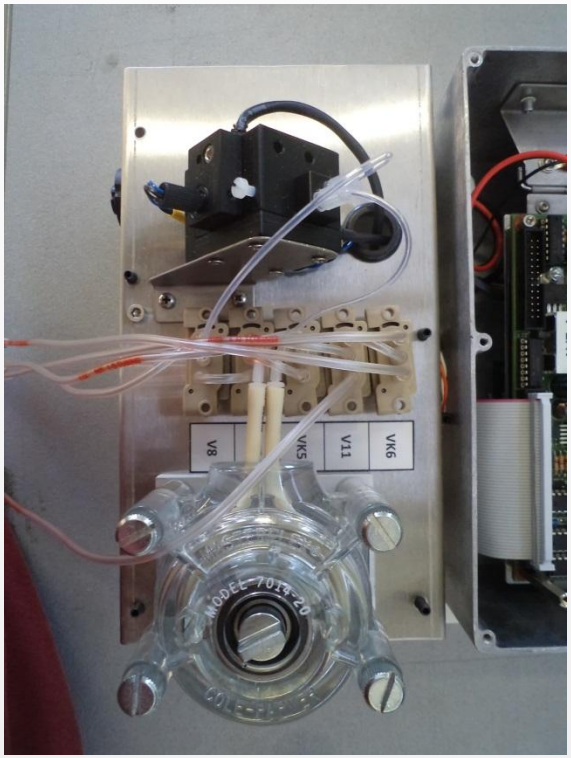
The advance: MicroLFA module

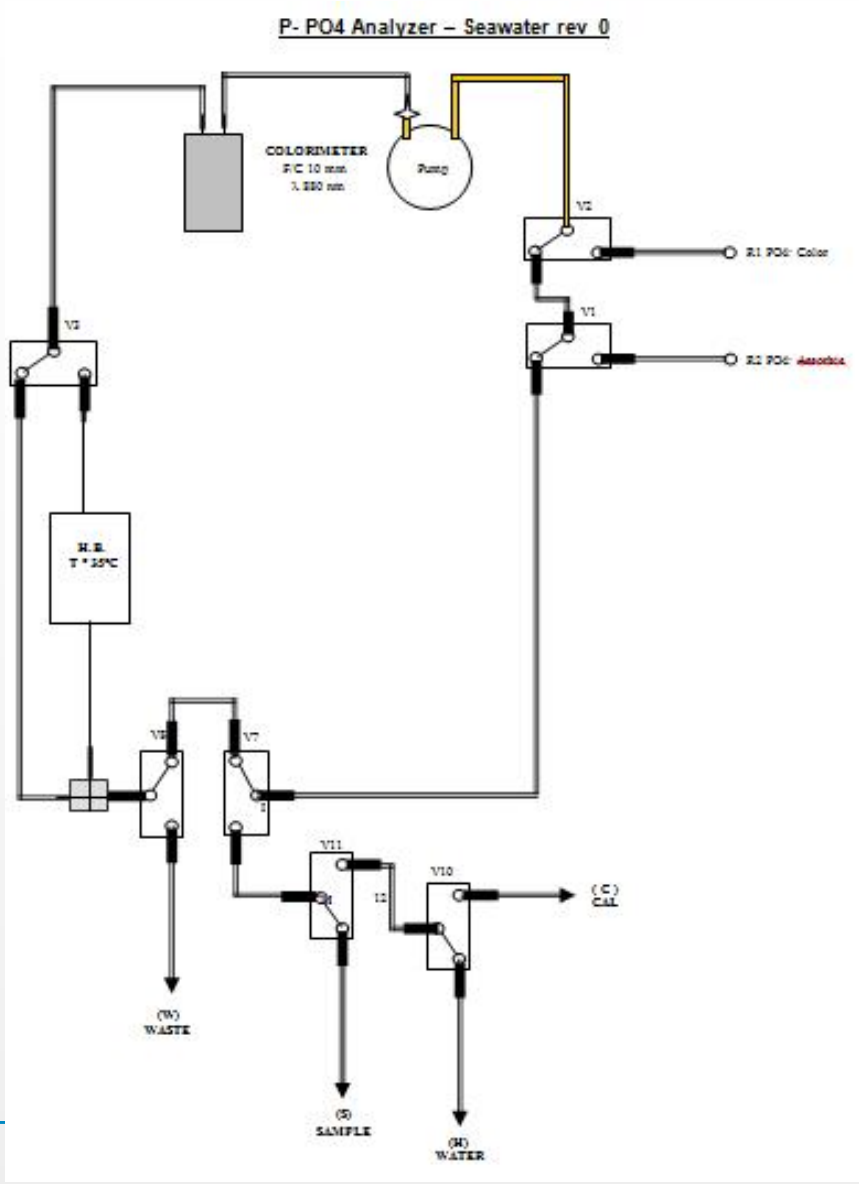


MicroLFA module

- Very simple hydraulics directly accessible by operator
- Complete separation between hydraulic and sealed electronic
- Suitable to run all nutrients methods already developed and tested on field
- Lower reagents consumption: 60 µL for most of the reagents used
- Fast “plug-in” hydraulic connector allows easy deployment and reagents changeover on board
- Power supply: 12 Vdc, 3 W stand-by, 6 W analysis, max. 1 A
- Very low maintenance
- Suitable for long term deployment.

The micro Loop Flow Reactor





Nutrients analytical methods using microLFA technology

- **AMMONIA (12 min.):**
  OPA fluorimetric method, 6 ppb
- **NITRITE (5 min.): NED-SAA, 1 ppb**
- **NITRATE + NITRITE (12 min.):**
  UV reduction method + NED-SAA, 5 ppb
- **ORTOPHOSPHATE (5 min.):**
  Molibdate-Antimony, 3 ppb

	NH_4-N	NO_2-N	NO_3-N	PO_4-P
Recovery (%)	96	126	94	109
RSD (%)	22.3	1.2	8.6	4.2
LOD (ppb)	6	1	5	3
LOQ (ppb)	20	3	15	10

Source: BOKU Vienna, project WARMER

http://www.projectwarmer.eu

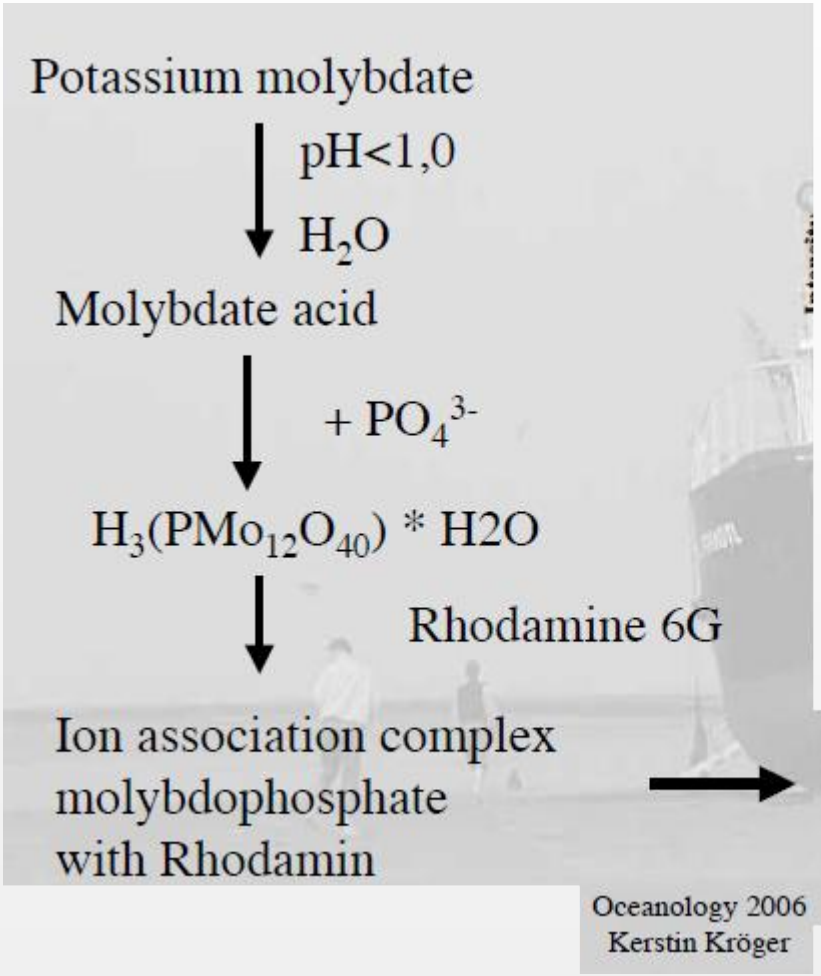
Analytical procedures for nutrients

	PO_4-P [10,11]	NH_4-N [9,10]	$(NO_3 + NO_2)$-N [9,10]	NO_2-N [9,10]
Filtration	yes	yes	yes	yes
Sampling	90 sec	90 sec	90 sec	90 sec
Sample blank reading	---	yes	---	---
Injection of first reagent	Acid Molybdtate	OPA	DTPA	SAA
Sample blank reading	yes	---	yes	yes
UV reduction	---	---	5 min	---
Second reagent injection	Ascorbic acid	---	SAA	NED
Mixing	yes	yes	yes	yes
Third reagent injection	---	---	NED	---
Temperature conditioning	25 °C*	45 °C, 6 min.	---	---
Duration of analysis	5 min	12 min	12 min	5 min
Flow cell	20 mm	10 mm	20 mm	20 mm
Wavelength/ Detection method [9,10,11]	880 nm, Spectrophotometric	370/420nm Fluorometric	525 nm Spectrophotometric	525 nm Spectrophotometric
Range	5-500 µg/L	3-1000 µg/L	10-500 µg/L	2-200 µg/L
Wash cycle	50 sec	50 sec	50 sec	50 sec
Inlet line back wash	---	---	---	5 sec, DIC /acid

* if required under low ambient temperature, water sample temperature could be increased to 25 °C

Advanced fluorimetric methods

PO_4



NO_2

The nitrite undergoes a diazotization with fluorosceinamine in an acidic medium. After sufficient incubation the reaction is completed by addition of a strong base. The resulting dye is measured fluorometrically (480nm excitation and 520nm emission) and is directly proportional to concentration[1].

[1] Axelrod, H. *et al*, Anal. Chem., **47**, 922-924 (1975).

MicroLFA: available parameters

- Nutrients: NH_3, NO_3+NO_2, NO_2 and PO_4
- SiO_2
- Total Phosphorus (measurement time 1 h)
- Total Nitrogen (measurement time 30 min.)
- Metal ions like Cr^{6+}, Al, Cu, Iron, Zn, Mn
- Urea.

MicroLFA technical features

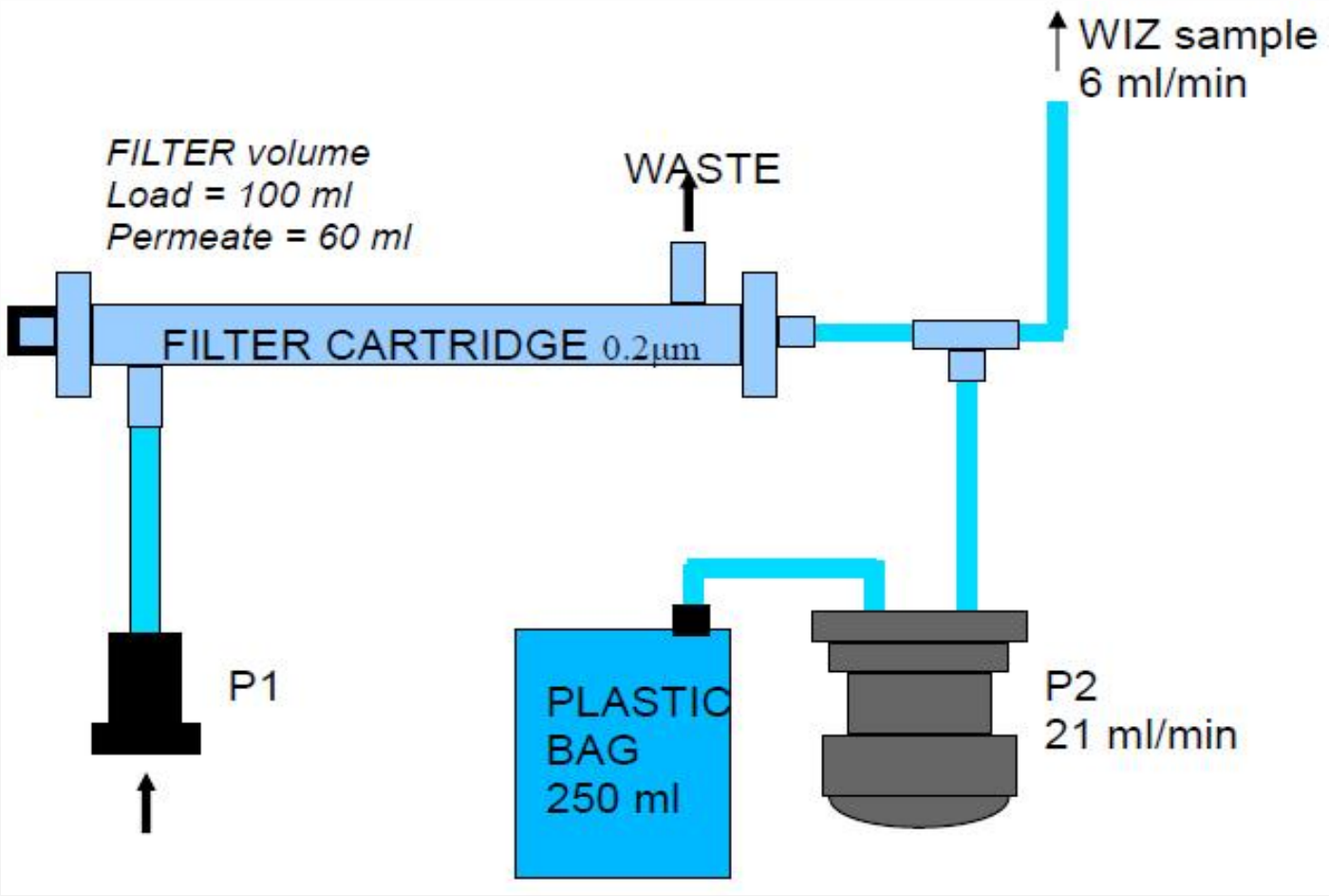
- **automatic sample blank correction**
- **automatic washing**
- **automatic sample dilution allows double scale measurements**
- **plug-in multi-hydraulic connector available for easy reagents changeover**
- **compactness and modularity allow easy integration in Ferrybox**
- **RS-232 protocol compatibility with Micromac-1000 and sondes**
- **compact dimensions: 270 (H) x 150 (L)x 175 (W) mm, hydraulics / electronics.**

Proposed field test under JERICO TransNational Access program

Submitted a proposal to test the MicroLFA modules in the following HZG's facilities:

- **Cuxhaven fixed monitoring station at the Elbe river mouth**
- **Ferrybox system on a regular route.**

0.2 microns filtration unit with auto back-wash



Requirements for a chemical analyzer in a Ferrybox system

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DONE !

THANK YOU

FOR YOUR KIND ATTENTION