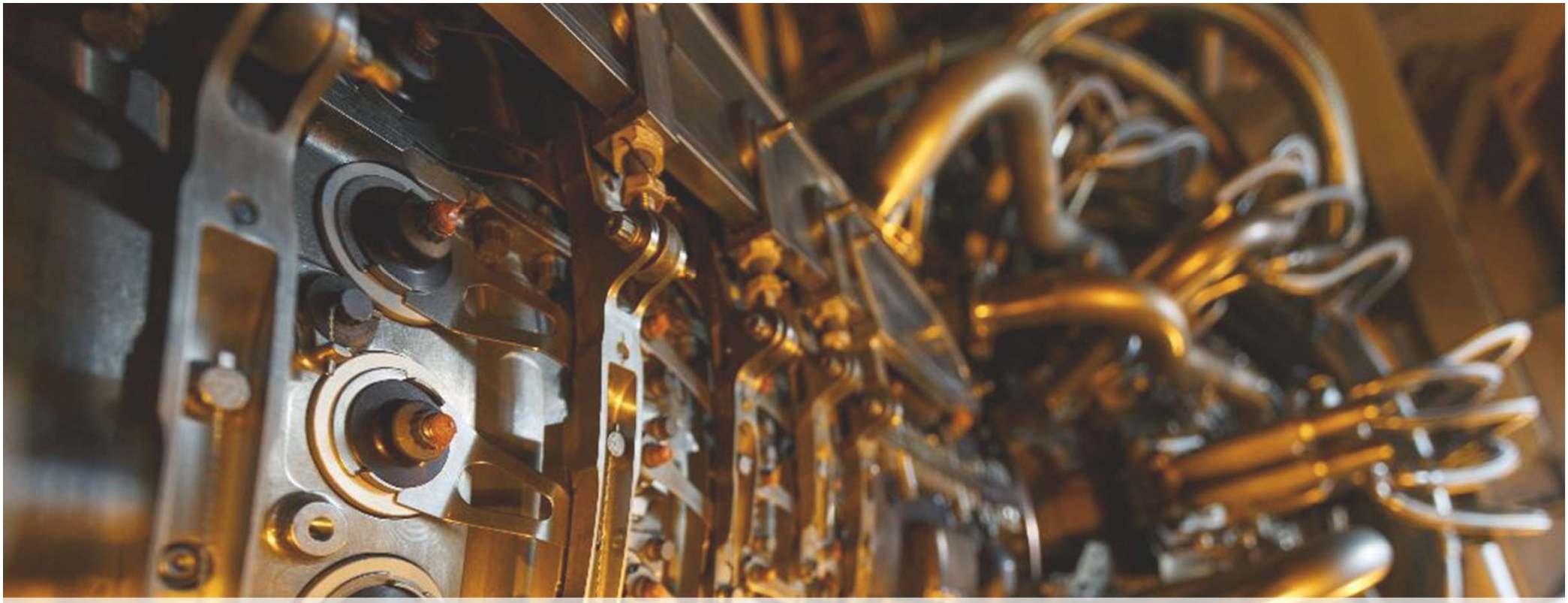


Spectrolytic

Innovative Solutions in Spectroscopy

FluidInspectIR
Mid-Infrared Analyser Platform

Spectrolytic 2023

Introduction to Spectrolytic

Spectrolytic GmbH – Wackersdorf Germany

- Product / Hardware Development
- Manufacturing

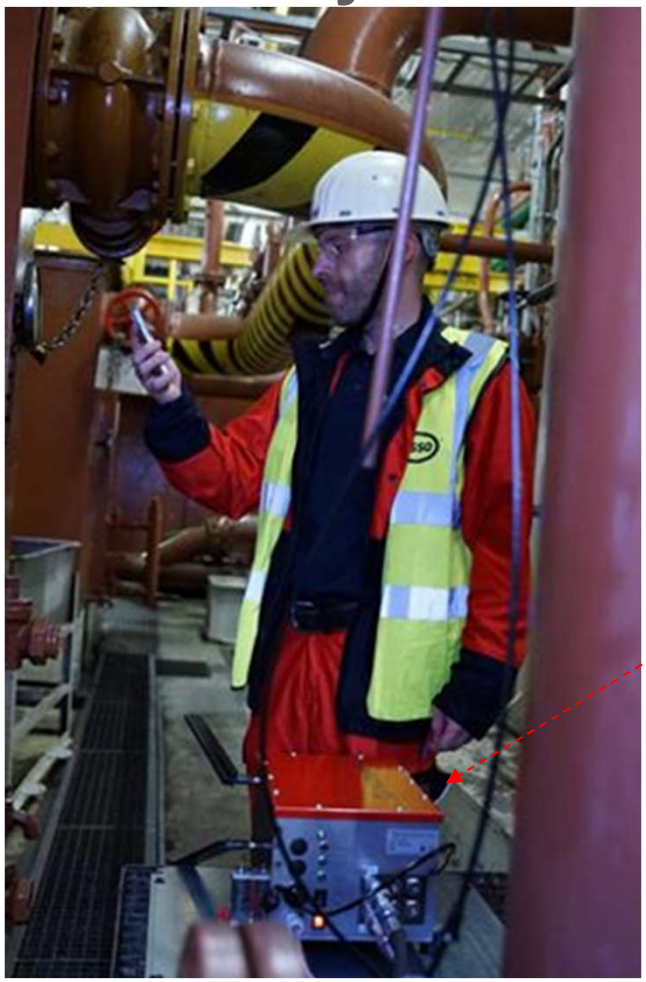
Spectrolytic Ltd – Edinburgh, Scotland

- Sales & Marketing
- Product / Hardware Development
- Customer Support & Application development
- Software development
- Consulting

History

- Fully operational since 2016
- Organically grown with no external investors

FluidInspectIR® validated together with Exxon Mobil for oil analysis



Mobil Lubricants Europe
5,866 followers
3mo •

Meet Rüdiger Kempf, one of Mobil's most experienced Field Lubrication Engineers. In many ways, he's like a roving CSI, except the 'crime scenes' he investigates are customers' operational emergencies – from worrying wear to costly breakdowns.

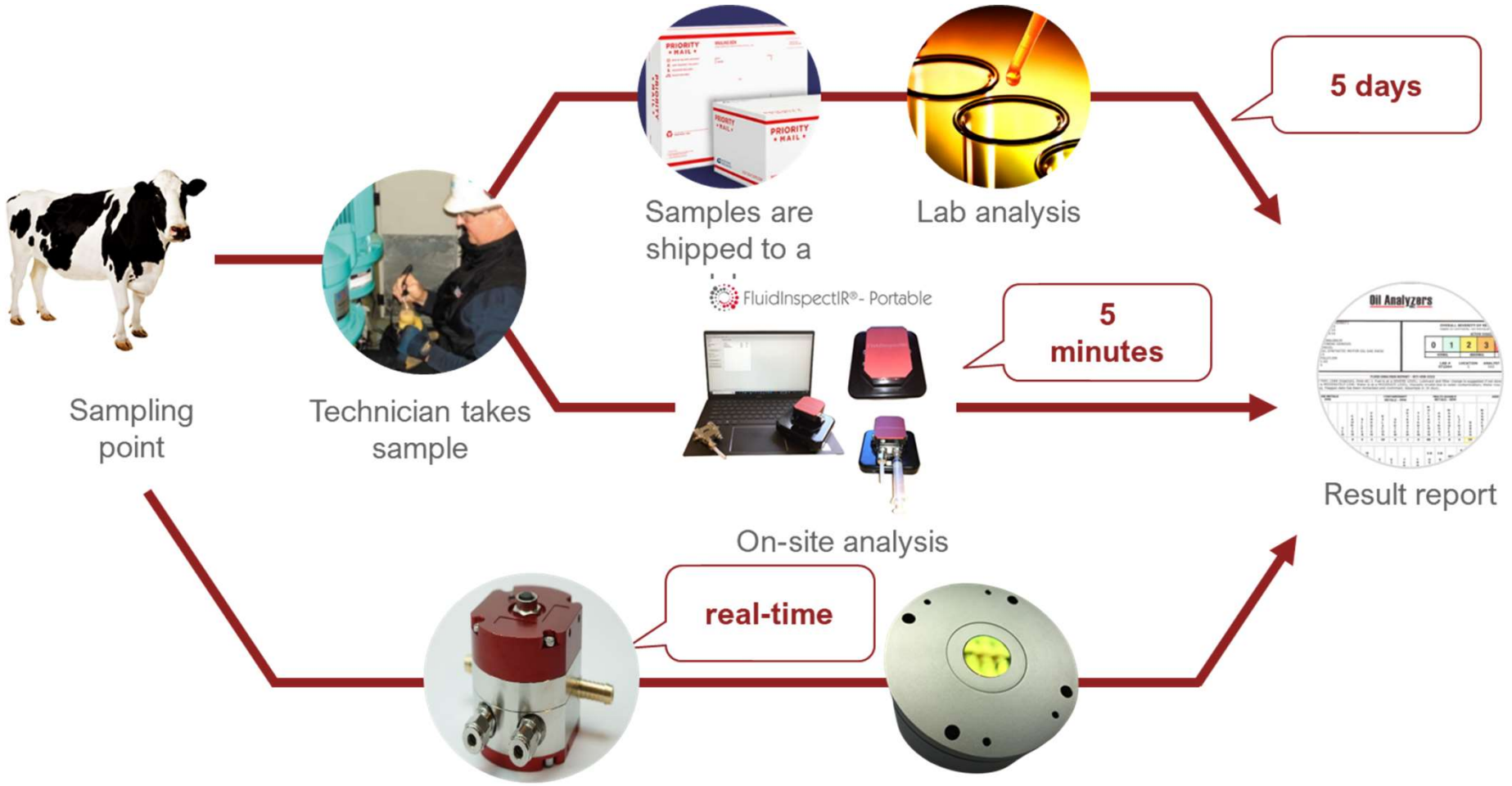
Rüdiger typically spends 3 days a week in the field, conducting forensic lubrication analysis in industries as diverse as steel and paper. His tools? A laptop, mobile and oil sampling equipment – giving him critical evidence on machines' inner workings without taking them apart.

"My job is fascinating! Each day is different and when I come across a really challenging problem, I can call upon specialist colleagues from our Mobil Serv Lubricant Analysis unit or Equipment Builder department to help me dig into the causes and solutions. Customers really appreciate solutions that have been tailored to their operation."

#ProgressWithMobil #fieldengineer #lubrication #oilanalysis

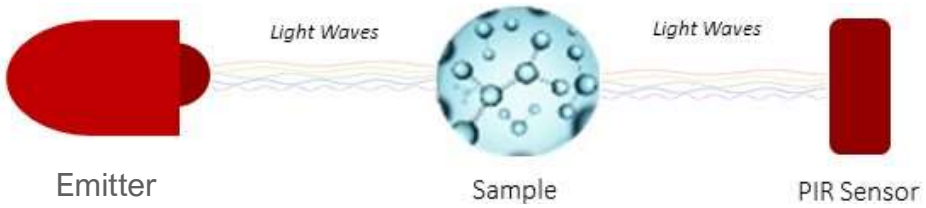
FluidInspectIR® INLINE by Spectrolytic

Spectrolytic Solution - From 5 days to real-time



FluidInspectIR® - How does it work & Why Mid IR

Lab based analysis uses FTIR spectroscopy to determine many sample parameters



A broad band emitter emits **light through a sample**.

The molecules in the sample **absorb certain wavelengths** of the light while others pass through the sample.

The **wavelength that is absorbed** by the sample can be linked to certain molecular structures / paramters and the concentration can be quantified

Monitoring changes in the absorption spectrum over time provides information about **concentration changes of relevant molecules** and quality of the sample

Mid-infrared light from 2um-12um is called the fingerprint region as light absorption can be used to identify molecules

Mid-infrared light absorption happens at the fundamental transition, so the math becomes easy as no harmonics

About a factor 100 less samples needed to generate an accurate calibration file

Product Portfolio

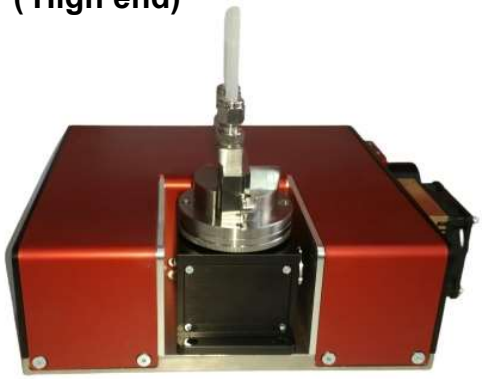
All products have no moving parts, are robust and designed for inline/field use

Products are based on a common platform and can be easily customised depending on application

MIRS-T and MIRS-A

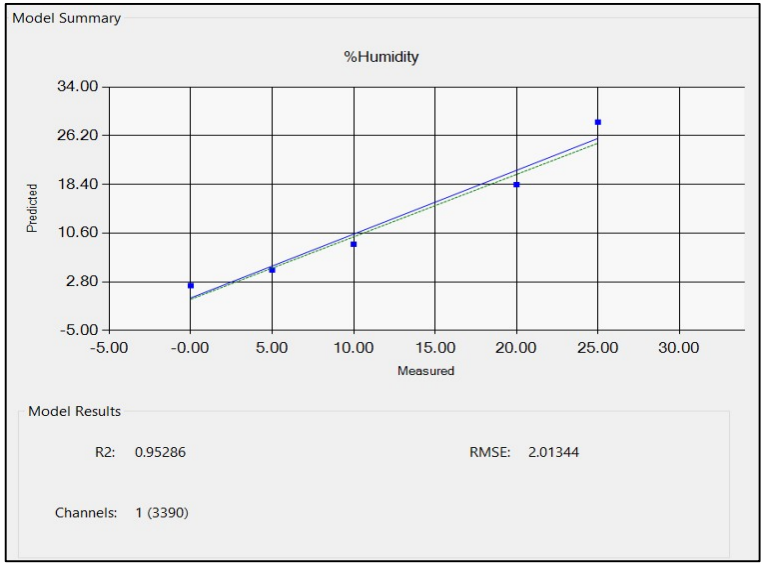
FluidinspectIR Portable

Static FTIR IR Griffin (High end)

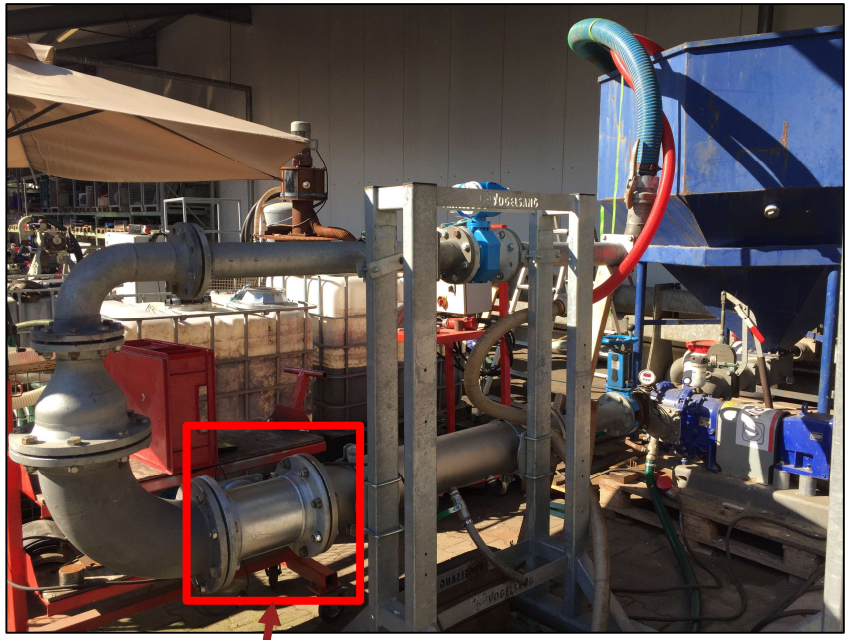


Example Applications: Humidity in soil

- Initial tests to measure humidity in soil
- Measurements were done using Spectrolytic ATR sensor
- Soil humidity is an important factor during the seeding process
- First results below look promising and a very good correlation to reference analysis
- Next step is miniaturization of the sensor and full integration



Example Applications: Inline Manure analysis



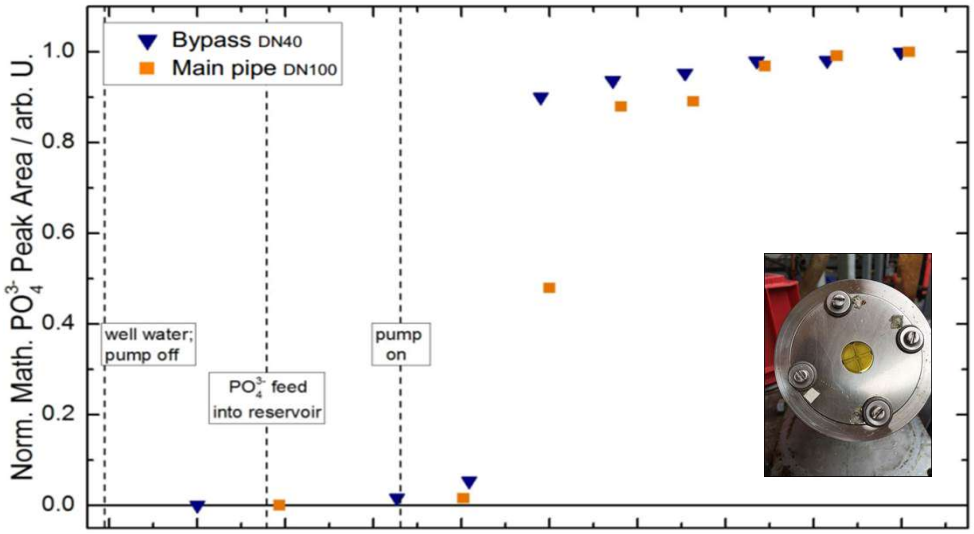
MIRS sensor mounted in pipe

Comms cable to laptop

Example Applications: Inline Manure Analysis

— Comparison with N.P.K solutions

Spectrometer	Parameter	Phosphate PO_4	Ammonium NH_4^+	Nitrate NO_3^-	Urea CH_4N_2O
Handheld Spectrolytic	Factor	4	4	4	4
	R^2 of CV	0.997	0.999	0.998	0.968
	RMSE CV / %	4.1	2.6	3.0	10.1
ATR FTIR BRUKER	Factor	4	4	4	4
	R^2 of CV	0.999	0.999	0.998	0.997
	RMSE CV / %	2.5	1.85	3.7	4.0



- Targeted to measure Total Nitrogen, Ammoniac, Phosphate and Total Solids
- Designed for inline measurements to monitor manure spreading to ensure that legal limits are not exceeded
- Can be integrated into manure pump or manure tank
- Very good accuracy achieved on test solutions

Example Applications: Inline Manure Analysis

- Data below show real time data of inline manure set-up as shown in previous slide (pig manure)
- Optimizing measurement process and algorithms resulted in a factor 4 improvement
- Still significant scope to further improve the system by optimizing additional parameters
- MIR manure sensors will be significantly more economical in maintaining calibration files as each year a new calibration has to be developed.

All measurements

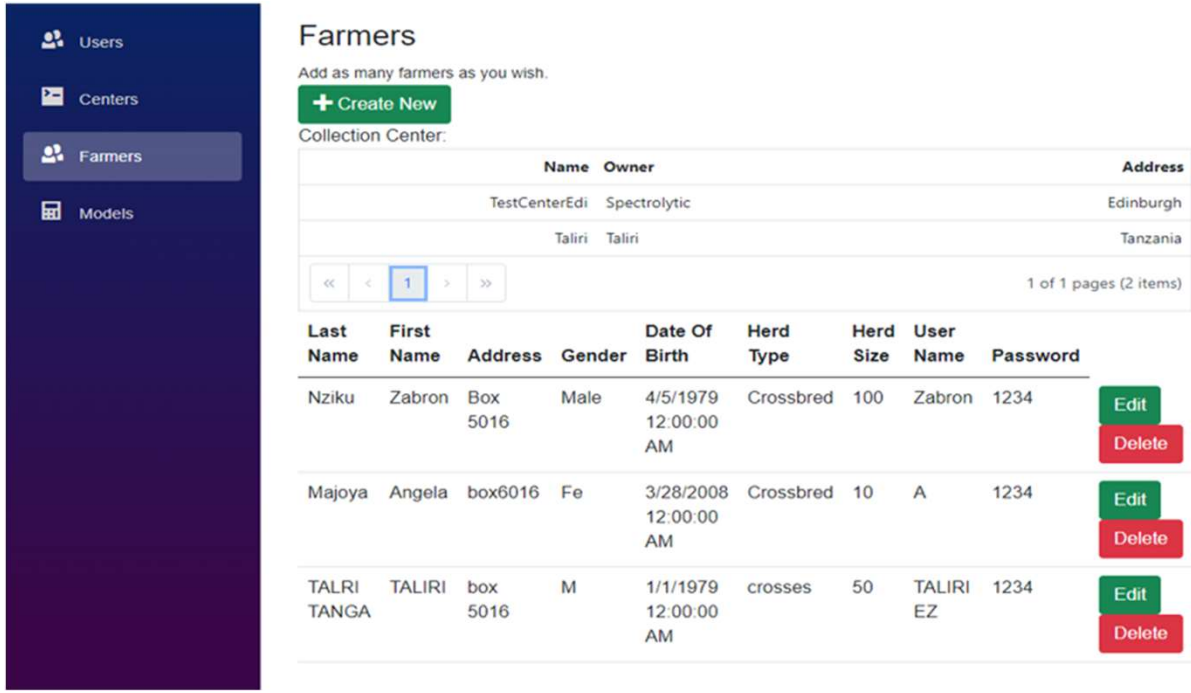
	Ref Channel						
Date	Signal	%T	Temp		Total Nitrogen	TS%	Ammoniacal
11:30:46	383.00	71.60	19.06		4.708876	5.714236	0.972861
11:37:45	374.00	70.05	26.5		6.743984	7.30223	1.726021
11:43:21			29.81		7.608752	7.977009	2.011348
11:48:47			30.69		7.828747	8.148672	2.104293
11:54:25			30.25		7.766816	8.100347	2.120802
12:00:59			28.13		7.216206	7.670705	1.988906
12:06:20			31.13		7.809808	8.133893	2.175036
12:11:53			30.69		7.764447	8.098498	2.163346
12:17:17			31.25		7.903855	8.207278	2.214072
12:23:28			29		7.311225	7.744849	2.064779
12:30:01	373.00	69.91	28.19		7.013111	7.512231	1.95898
12:36:04			29.13		7.253737	7.699991	2.047626
12:41:29			31.25		7.664374	8.020411	2.154496
12:46:50	372.00	69.56	31.63		7.773384	8.105472	2.213658
12:52:36			30.25		7.43011	7.837615	2.111696
12:59:49			27.13		6.637236	7.218935	1.833349
13:05:31			30.06		7.300038	7.73612	2.081622
13:14:02	377.00	70.40	25.69		6.048588	6.759613	1.621677
13:19:28			30.94		7.336764	7.764777	2.099845
14:55:29	379.00	70.89	22.75		5.167991	6.072483	1.264949
15:03:55			24.88		5.9564	6.687679	1.579469
15:29:15	379.00	70.99	22.63		5.122557	6.037031	1.203133
		Max Te	31.63	Mean	6.971227545	7.479548864	1.895998364
		Min Te	19.06	Stdev	[illegible]	[illegible]	[illegible]
		Range	12.57	%Non-Unif	13.87316536	10.08953371	18.73877936
				Max %	7.903855	8.207278	2.214072
				Min %	4.708876	5.714236	0.972861
				Range	3.194979	2.493042	1.241211

Stable Temp Only

Date	Temp		Total Nitrogen	TS%	Ammoniacal
11:30:46					
11:37:45					
11:43:21	29.81		7.608752	7.977009	2.011348
11:48:47	30.69		7.828747	8.148672	2.104293
11:54:25	30.25		7.766816	8.100347	2.120802
12:00:59	28.13		7.216206	7.670705	1.988906
12:06:20	31.13		7.809808	8.133893	2.175036
12:11:53	30.69		7.764447	8.098498	2.163346
12:17:17	31.25		7.903855	8.207278	2.214072
12:23:28	29		7.311225	7.744849	2.064779
12:30:01	28.19		7.013111	7.512231	1.95898
12:36:04	29.13		7.253737	7.699991	2.047626
12:41:29	31.25		7.664374	8.020411	2.154496
12:46:50	31.63		7.773384	8.105472	2.213658
12:52:36	30.25		7.43011	7.837615	2.111696
12:59:49					
13:05:31					
13:14:02					
13:19:28					
14:55:29					
15:03:55					
15:29:15					
Max Temp	31.63	Mean	7.564967077	7.942843923	2.102233692
Min Temp	28.13	Stdev	[illegible]	[illegible]	[illegible]
Range	3.5	%Non-Unif	3.788677544	2.815660952	3.959384936
		Max %	7.903855	8.207278	2.214072
		Min %	7.013111	7.512231	1.95898
		Range	0.890744	0.695047	0.255092

Example Applications: Digitizing Milk analysis in Tanzania

- Milk composition (Fat, Protein, Lactose) and adulterants
- Cloud based data analysis system providing feedback and learning for all stake holders
- Easy to use and reliable
- Both Mains and battery powered options

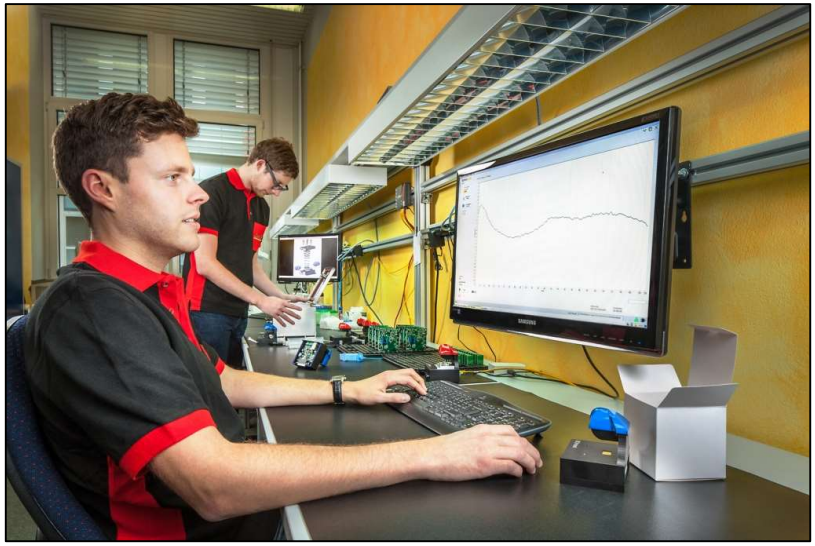


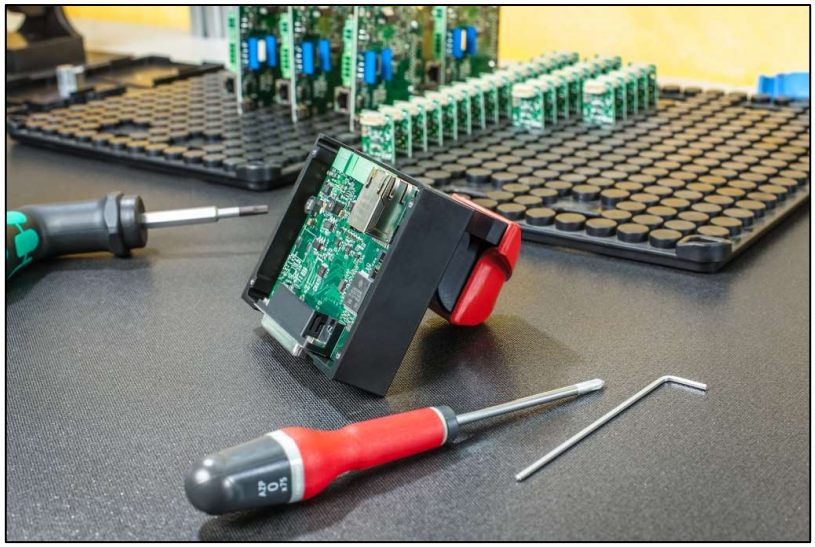
Example Applications: Milk Supply Chain Management

- Measure milk composition inline directly when pick-up at farmer
- Integration of milk analysis system directly into truck
- Milk composition is directly shared with all stake holders (farmers, dairies, etc) increasing efficiencies
  - Milk can be directly processed by dairies, no waiting, no cooling costs etc
- Extremely stable & robust platform technology enables that (Sensor has been qualified for military application)

Manufacturing

- All products are manufactured by Spectrolytic in Germany
- Production is carried out in an ISO 9001 qualified manufacturing environment
- In-House production of key components allows fast response time
- In-house competencies are
    - Manufacture of non-standard cabling and connectors
    - Configuration of Control boxes
    - Customized metal works
    - Electronic & Mechanical design using state of the art tools
- Automated stock control





Spectrolytic

Innovative Solutions in Spectroscopy

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