

MEL Systems/Filtertechnik presentation

On the Spot Oil Analysis Challenge



*Introducing the most complete portable oil analysis kit on the market
Tailor made for the Wind Market*

Filtertechnik Ltd *An Introduction*



Originally a division of Hydrotechnik UK Limited Filtertechnik became a stand alone company on 1.1.2011.

- 1990: Hydrotechnik UK formed
- 1996: Started to sell filtration solutions
- 2005: Started to sell Own Branded Laser counters
- 2007/8: Became large player in UK's biodiesel purification which morphed into diesel fuel filtration
- 2010: Developed First Generation Particle Pal Units (over 500 sold in Hydraulic, Lube & diesel fuel applications)
- 2011: Filtertechnik spun out of Hydrotechnik UK Limited to become a separate limited entity
- 2017: Sells diesel fuel filtration division to IPU
- 2017: Invest in and renewed focus on the oils market
Launch of Particle Pal Version 2
- 2018: Launch of Particle Pal *Life*
Launch of extended Particle Pal range

Filtertechnik Ltd *An Introduction*



Key Staff

2018 Head count: Filtertechnik 14 (*total headcount 40*)
Turnover £1.8m, total group £7.2m

Richard Price: Managing Director
Daniel Whittaker: Technical Director
Will Struthers-Frost: Head of R&D
Sharon McMahon: Internal Sales Manager



MEL Systems

Mel-Systems is Filtertechnik's partner located in Italy with strong experience on Oil Quality sensor applications with wide connections and knowledge of customer needs in the wind market.

Mel Systems cooperated with Filtertechnikino in development of the Particle Pal Pro with lab and field tests.

MEL-Systems are the company that originally submitted the entry for the Wind Innovators Challenge.

Overview

1. Filtertechnik launched a new 'On the Spot Oil Analysis' product in mid 2018 after a year of R&D and product development
2. Mel Systems and Filtertechnik entered this product in the Wind Innovators Challenge
3. After field trials at various Wind Farms we quickly realized that our new product required specific design changes due to unique challenges in this sector
4. Filtertechnik worked swiftly to adopt new technology and design new components to overcome these technical challenges
5. The resultant product truly exceeds the challenges the Wind Market presents with many excellent new features never seen before in any On the Spot Oil Analysis products
6. In summary, the Wind Innovators Challenge competition spurred us on to develop a world class product that is commercially viable, scalable and can be further enhanced in the coming months and years

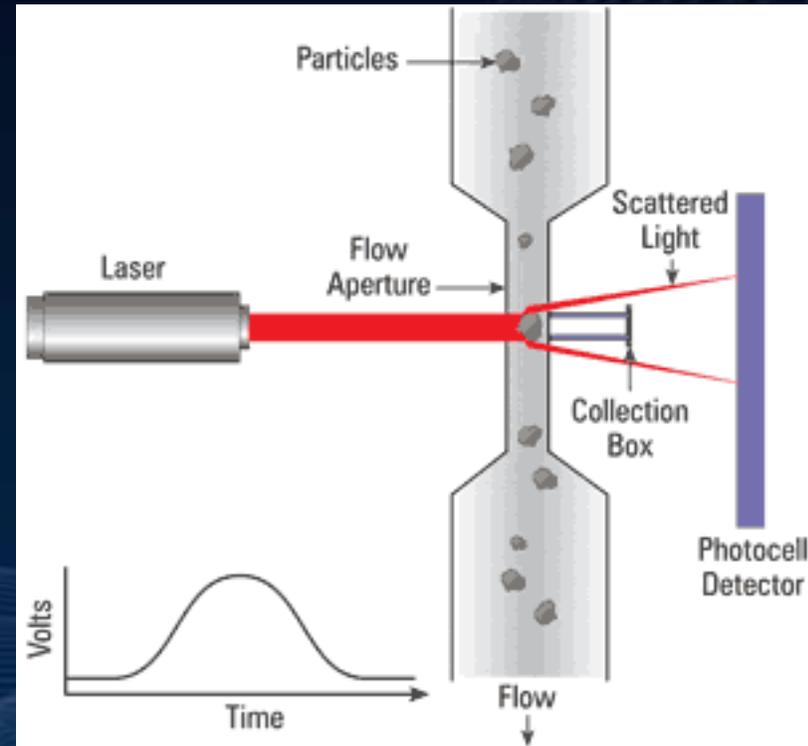
Existing Technology Background

Laser Particle counters work by counting shadows created when particles pass between a laser light and a photocell detector

This offers good accuracy and repeatability, and has long been an accepted method of counting particles

By introducing additional sensors, Filtertechnik has created an interesting family of portable particle counters

However, some downsides to this technology have been identified when deployed in the Wind turbine market (more later)



Background

Filtertechnik have been manufacturing Laser based oil particle counters since 2005

We offer on-line and portable particle counting solutions

Both utilize Filtertechnik's PC9000 Laser counter which gives:

- ISO, NAS and SAE Counts
- Trending software
- Accurate to +/- 0.5 of an ISO Code



In-line



Portable

New Product launched mid 2018

Introducing Particle Pal Life

A revolutionary new tablet based portable oil analysis kit launched 2018

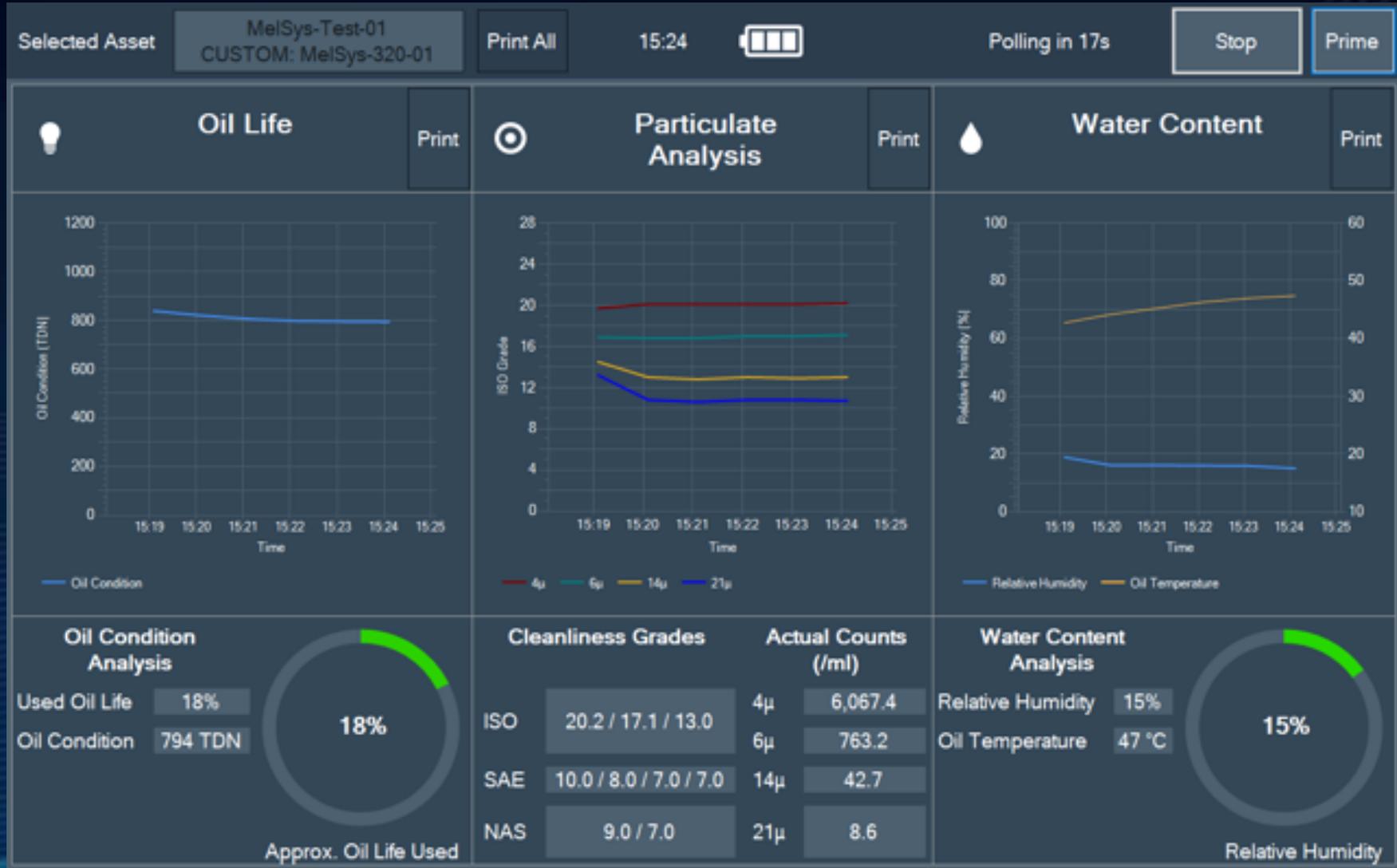
Main features

- Particulate levels
- Water Content
- Remaining Life of any oil - which is a world first
- Over 500 oil life profiles included in the software
- Self contained pump and battery allowing testing from sample bottles or live system up to 350 Bar
- A genuinely new and innovative solution to on the spot oil analysis, ideal for Field Engineers or lab use
- On the spot oil analysis kits give Engineers immediate insight as to the state of their oil, rather than waiting for lab results, allowing Engineers to make informed choices



Particle Pal *Life*: Launched in mid 2018

Screen shot showing the connected sensors



However!

The Wind Market presents unique technical challenges

1. Oil Viscosity

- 320cSt gear oil at 10°C is nearly 3,000cSt
- A challenge for our standard Laser Counter which passes oil through a 1mm aperture before being counted by the laser

2. Aeration

- Oil can be heavily aerated, even after standing for long periods
- We bundle flasks to de-aerate oil for standard tests >68cSt
 - Not ideal in a wind turbine nacelle

3. Cold starts

- Oil left in the unit overnight can present pump start up issues due to viscosity of the oil, inertia and the immediate pressure requirements

Temperature °C	Viscosity (cSt)								
	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	ISO 460	ISO 680
10.0	161	262	442	711	1185	1921	2911	4827	8042
12.0	141	227	379	605	1001	1611	2435	3991	6588
14.0	124	198	327	518	850	1358	2048	3318	5427
16.0	109	173	283	446	726	1150	1730	2774	4496
18.0	97	152	246	385	622	970	1469	2301	3745
20.0	86	134	215	334	536	833	1254	1968	3135
22.0	77	118	188	291	464	720	1074	1670	2638
24.0	69	105	166	255	403	611	925	1423	2230
26.0	62	94	147	224	352	538	799	1211	1894
28.0	56	84	130	198	308	469	694	1043	1616
30.0	51	75	116	175	271	409	604	905	1385
32.0	46	68	103	155	239	369	528	784	1192
34.0	42	61	93	139	212	326	464	683	1030
36.0	38	56	83	124	188	279	408	596	894
38.0	35	50	75	111	168	257	361	521	778
40.0	32	46	68	100	150	220	320	460	680
42.0	29	42	62	90	135	195	285	405	596
44.0	27	38	56	82	121	177	254	360	525
46.0	25	35	51	74	109	158	227	330	463
48.0	23	33	47	67	99	142	204	285	411
50.0	21	30	43	62	90	128	183	255	365
52.0	20	28	39	56	82	116	166	228	325
54.0	19	26	36	52	74	105	150	205	291

So we went back to the drawing board, adopted new Digital Imaging technology and re-wrote our analysis software



Breakthrough technology - how it works:

- New particle counting camera takes 4 frames per second at incredible resolution and calculates the size and quantity of particulate on the fly. Most of the particulate shown cannot be seen by the naked eye.
- Broader micron size determination:
 - 4, 6, 10, 14, 21, 38, 70 and >100 microns
- Air & Gas Bubbles eliminated from the counts via the software
- It also has Shape Recognition in the software to categorize:
 - Fatigue Wear
 - Sliding Wear
 - Cutting Wear



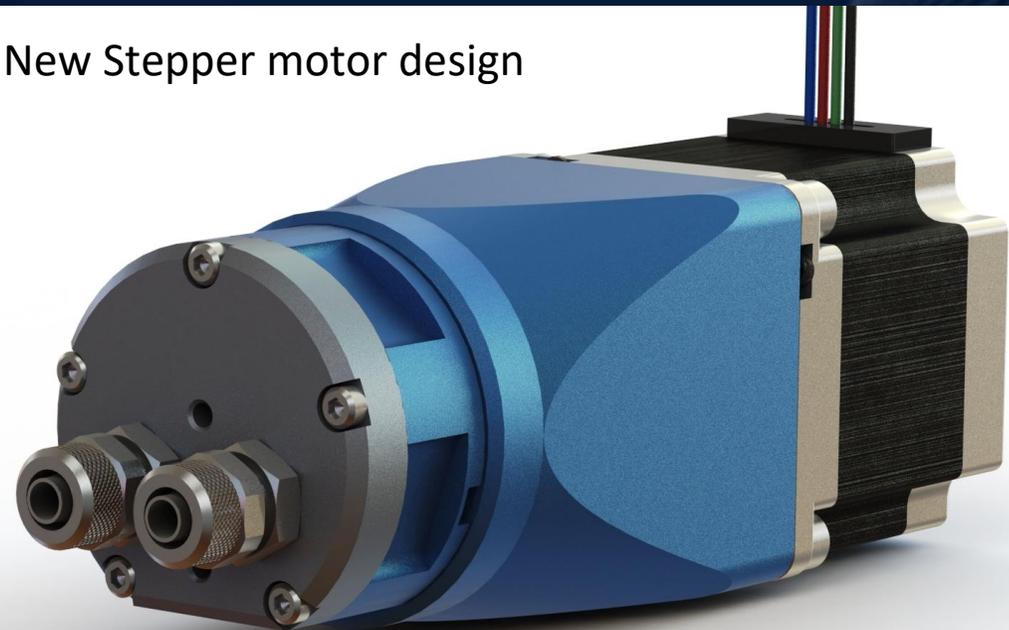
We also invented a new compact pump

To overcome cold starts and highly viscous oil problems we created a new stepper motor pump design for oils up to 3,000cst

Immediate full torque on start up/slow speeds

Completely controllable flow rate from 100mL/minute up to 500mL/Min

New Stepper motor design



We managed to package all this into our existing portable case design

Main features

- Particulate levels with bubble elimination
- Particle shape recognition
- Water Content
- Remaining Life of any Oil
- Store images for reporting
- New Spider graphs for understanding at a glance the condition of oil being tested
- Suitable for field use 6-8 hours of use on a single charge



New homepage screen



Selected Asset

01- PPVision
Fuchs, Cassida HF, 46

Print All
09:23

Idle

Start

Prime ✕

Water Content
Print

— Relative Humidity — Oil Temperature

Water Content Analysis

Relative Humidity 44%

Oil Temperature 22 °C

44%

Relative Humidity

Particulate Analysis
Print

— 4µ — 6µ — 14µ — 21µ — 38µ — 70µ

Cleanliness Classes

ISO (/ml)	19.3 / 18.6 / 16.8
SAE (/100ml)	12
NAS (/100ml)	11
Saturation	0
OD	0

Compensated Particles (/ml)

4µ	3,276	19.3
6µ	2,046	18.6
14µ	562	16.8
21µ	166	15.0
38µ	41	13.0
70µ	0	6.0
100µ	0	-

Oil Life

Oil Condition Analysis

Used Oil Life 20%

Oil Condition 779 TDN

20%

Approx. Oil Life Used

New detailed reporting screen



Particle Analysis (counts per mL)			
	Particles	Bubbles	ISO
>4	3276	4	19.3
>6	2046	4	18.6
>14	562	4	16.8
>21	166	4	15.0
>38	41	4	13.0
>70	0	0	6.0

5-15	0	0
15-25	0	0
25-50	0	0
50-100	0	0
>100	0	0

Root Cause Analysis			
Fatigue	172.0	Fatigue Wear:	Caution 100 - Alarm 300
Sliding	2.0	Sliding Wear:	Caution 50 - Alarm 100
Cutting	1.0	Cutting Wear:	Caution 50 - Alarm 100
Fiber	0.0	Fiber:	Caution 50 - Alarm 100

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Start Slide Zoom Export Open Folder



Spider graph showing all oil measurements at a glance

Images stored in a library for viewing

Commercial points

Future developments

- Continue to develop the software
- Integrate off-site backup/cloud
- Create stand alone continuously connected versions
- Include a Viscosity sensor as another oil quality touch point

Commercial Information

- List price each: €14,500
- Wind Market discounts:
 - 10 units: €11,400
 - 50 units: €9,450
 - 100 units: €8,550
- Currently being field tested
- Available early 2019

Market impact

- We expect the new instrument to be trialled by Wind Farm operators and then adopted by Field Engineers
- Significant operational savings from identifying oil related problems early, avoiding catastrophic failures
- Saving just 1 gearbox would more than justify adoption of this technology





**Thank you for the opportunity
and for your consideration**