CMF-S INTEGRITY ANALYSER
US FILTER MEMCOR/VIVENDI WATER SPONSORED

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CMF
Continuous Micro-filtration is a water filtration system using hollow microporous fibres to filter water supplies.

CMF-S
Continuous Micro-filtration - Submerged is an evolution of CMF, with a major difference being the modules and fibres are permanently submerged in a large water cell.

Integrity
In delivering a water supply to a community the integrity of the system is vitally important. When fibres break in the system, these must be detected and repaired. The CMF system has a proprietary product, the “Sonic Analyser” which is used for detection of air bubbles which appear due to broken fibres, when air is passed through the system.

Analysers for CMF-S
For the CMF-S system currently being developed there is no method for detecting the module within a cell containing broken fibres.

Research
Bubble Travel
When a fibre breaks the bubble emanating from that module travels vertically upwards, staying close to the module. Bubbles gather around the circumference of the module caps before escaping out to travel towards the surface of the water.

Accelerometer
An accelerometer is able to be used, since the bubbles travel to the cap, and do not simply escape to surrounding waters immediately. The accelerometer is placed upon the cap of the sub-manifold.

Signal Analysis
By applying a 4th order Butterworth filter to the CMF-S signal recorded, most of the background noise was able to be removed, leaving only the bubble information. This is then used to display to both audio and visual outputs.

Visual Output
Writing to an LCD panel every 300ms with a single level produces an effective bar graph. The output is generated from a moving sum of the maximum value from 10ms intervals, forming a moving window over three 300ms intervals.

Audio Output
By passing through a DAC, the output is available, for confirmation of the bubble sound.

Electronics
Micro-controller based
Battery operated, low power operation is desired to produce a handheld device. Hence, a micro-controller is preferred to a DSP. Unfortunately, this means the order of filter used is lower, and hence less precision can be attained. A Texas instruments MSP430 was used, being specially designed as a low power controller.

Other electronic components included anti-aliasing filters, buffering and amplification, the LCD, an audio output, ADC and DAC.

Results
CMF-S
The CMF-S response developed gave favourable results, correctly identifying a faulty module. The major problem identified was a need for a better water proof seal on the accelerometer and mounting being used.

Conclusion
The Integrity Analyser using digital filtering provides an accurate, versatile solution. Multiple systems can be monitored with this low power device. The prototype has been approved for further development towards a final product for worldwide usage.