Introduction

The IBIS Rheometer System (IRS) uses an advanced, novel method of measuring the visco-elastic properties of fluids.

The IRS applies a pseudo-random squeezing motion to a small sample volume of fluid and the complex viscosity and modulus are extracted at single frequency steps by Fourier analysis.

The IRS thus provides a frequency spectrum of the complex viscosity and modulus in a few seconds.

This makes the IRS particularly suitable for the measurement of visco-elastic properties of materials which change rapidly with time.

The IRS is a new product from Fischer-Cripps Laboratories Pty Ltd and was originally developed by the CSIRO Division of Applied Physics.

To perform a measurement, a small volume (a few ml) is put onto the bottom plate with a syringe or spatula. The top plate is lowered into position, and the software takes care of the rest. Measurement time depends on the frequency resolution selected and may be either 1 second or 10 seconds. Additional unattended measurements on the same sample may be performed at specified time intervals. After the measurements, the plates are simply wiped clean.

Features:

- Up to 1000 frequency steps analyzed in seconds
- Small sample size
- High phase resolution
- Sophisticated software
- Graphical output
- Automated gap setting
- Simple calibration
- Easy sample preparation and cleaning

Specifications:

- G' measured down to 10^{-4} Pa*
- η* down to 1mPas
- Phase angle resolution better than 2^{o} *
- Shear rate: $0.01s^{-1}$ $1000s^{-1}$ (approx)
- Force range: mN to N
- Gap setting resolution: 1.25μm
- Displacement amplitude: 0.02-25μm
- Measurement time: 1-10 seconds approx

Applications:

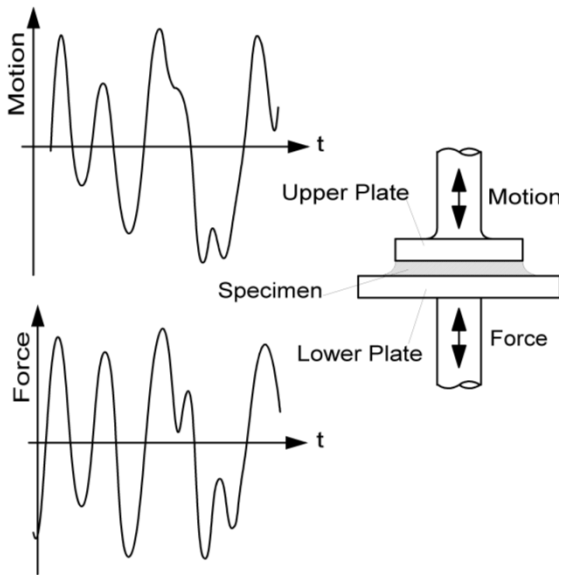
- Foodstuffs
- Biofluids
- Paints & Inks
- Building products
- Petroleum products
- Pharmaceuticals

Calibration

Separate force and displacement sensors are used and are individually and indepdently calibrated with traceable instrumentation.

A particular feature of the instrument is that the dynamic characteristics of the instrument itself are compensated for by virtue of a reference transfer function, which is automatically subtracted from the specimen response in the frequency domain. The results therefore reflect the dynamic characteristics of the specimen fluid.

The motion of the upper plate is by a closed loop displacement feedback circuit which operated in real-time within the electronics controller and is not simulated in software.

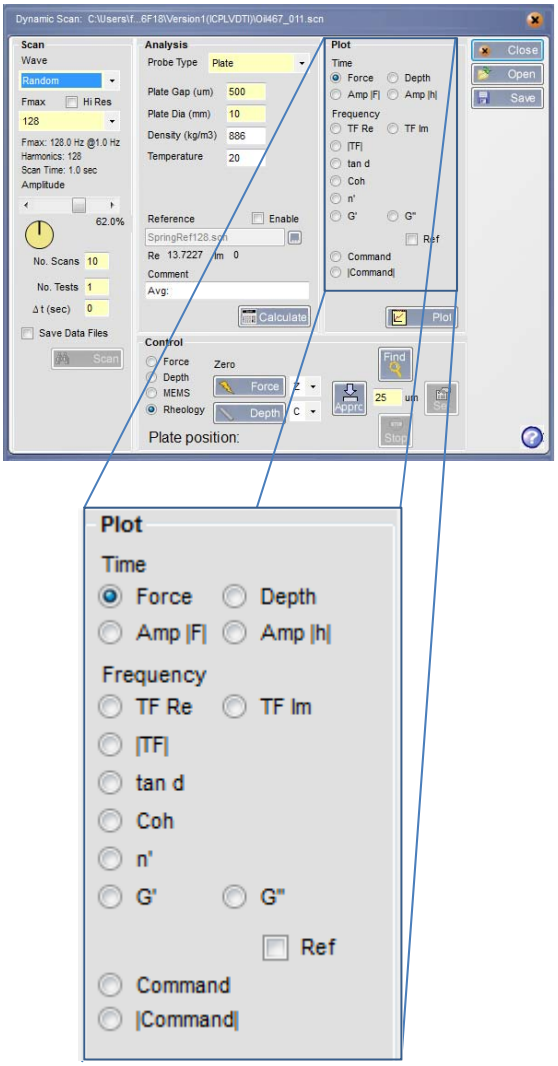


How it works:

The IRS applies a small amplitude random squeezing motion to a volume of sample fluid placed between two circular, parallel plates. The force generated within the fluid is measured using a highly sensitive piezo-electric AC load cell attached to the lower plate.

The displacement and force are continuously monitored and a Fourier transform is used to extract complex viscosity, storage and loss modulus at individual frequency steps in the range 0.1 - 100 Hz.

The standard operating mode is 1 to 100 Hz at 128 frequency steps with a sample period of 1 second. A high resolution setting provides 1024 frequency steps with a sample period of 10 seconds.



Software:

The IBIS Rheometer System is controlled by custom-written Windows software. The user sets the scan conditions (such as maximum frequency component and number of frequency steps. After a scan, raw data in the form of a transfer function of force and displacement is used together with sophisticated Fourier analysis to produce a graphical display of complex viscosity and modulus as a function of frequency in a matter of seconds. Tests may be scheduled for unattended operation over several hours so as to monitor change in properties over time.

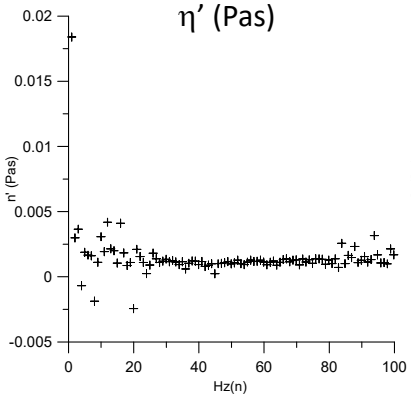
Data output:

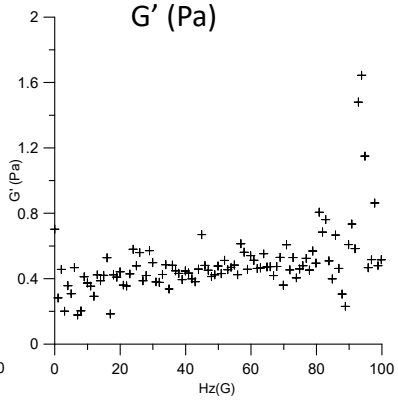
The IRS program produces graphical output of the force and depth time signals, the force and displacement amplitude spectrum, as well as the frequency spectrum for the real and imaginary parts of the transfer function, the magnitude of the transfer function, tan δ, the Coherence, the real part of the viscosity in Pas, and the Storage and Loss Moduli in Pa. All data is stored as ASCII text for easy importation into other software.

Sample Results

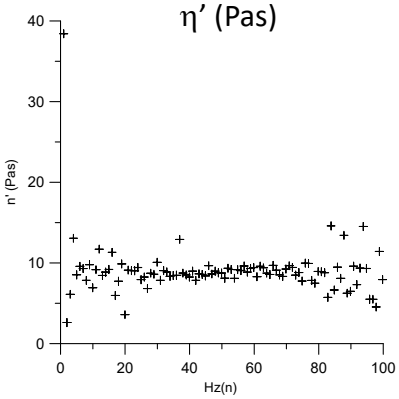
The results shown here were taken on readily available samples of some common fluids. Time to collect the full frequency spectrum up to 100 Hz was typically 1 second with five scans performed and the results averaged. All tests at 20°C. The load cell operates in AC mode only hence the loss of resolution at frequencies below about 10 Hz.

Distilled Water

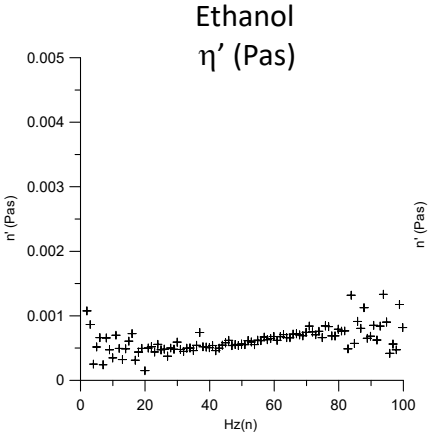




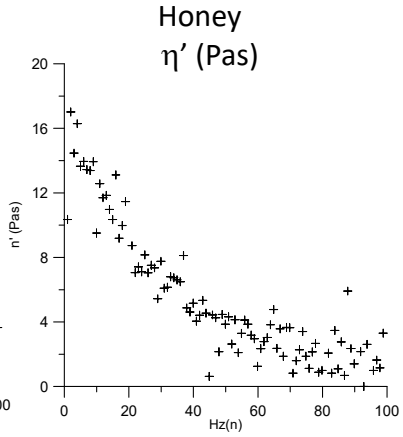
Standard Oil of η' = 8.9 Pas



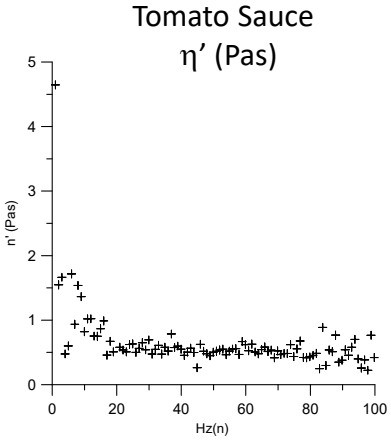
Ethanol



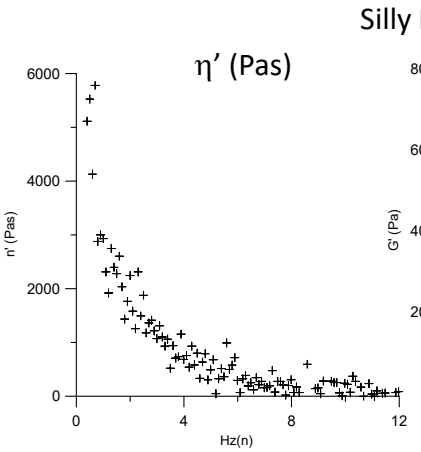
Honey

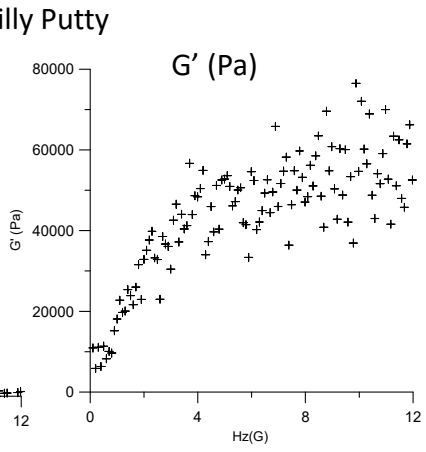


Tomato Sauce

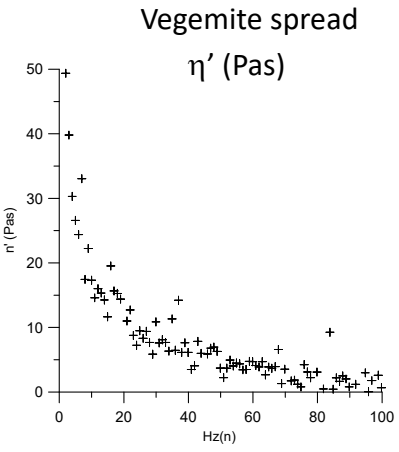


Silly Putty





Vegemite spread



History

The IBIS Rheometer System is a version of the original Micro Fourier Rheometer developed at the CSIRO Division of Applied Physics with Dr M.V. Swain and Dr J.S. Field.

By 2003, the instrument had been eveloped to an industrial prototype form and then licenced to an Australian manufacturer.

With the expiration of the Australian Patent in April 2015, the technology is now avialable via a wider choice of manufacturers.

Dr Cripps managed the Micro Fourier Rheometer project at CSIRO from 1999 to 2003. The original concept from CSIRO has been retained, but Fischer-Cripps Laboratories has reduced the complexity and cost of the instrument so as to make it a more economical proposition and to bring the price within reach of a modest laboratory undertaking research work in rheology.

Fischer-Cripps Laboratories Pty Ltd was established in 1966 and has been involved with mechanical property testing of materials since 1990.

Local representative

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