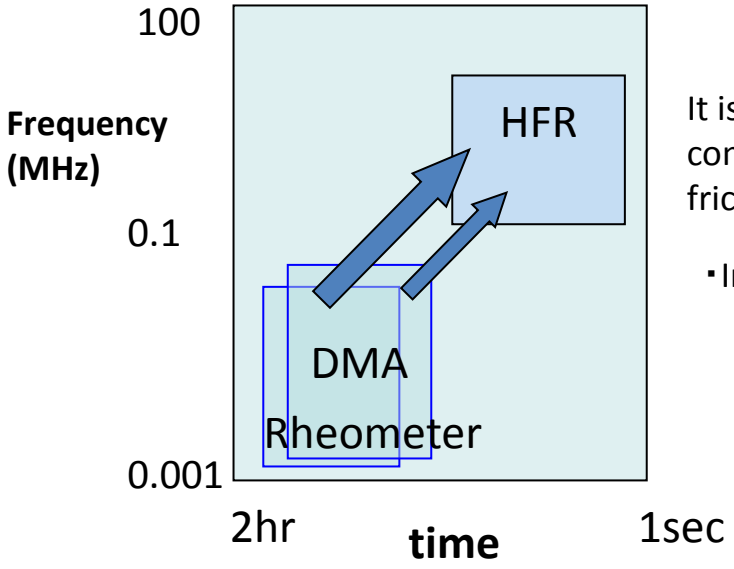
OUTLINE of HFR

Highfrequency Viscoelasticity Corporation

To realize the 3R that are desired in the industry

- It has specialized in the high frequency region
- It can be measured in the field environment (Real condition)
  （Unnecessary cryostat　Unnecessary temperature-time conversion）
- Short measurement time (Real time)
- You can measure the actual thing (Real sample)



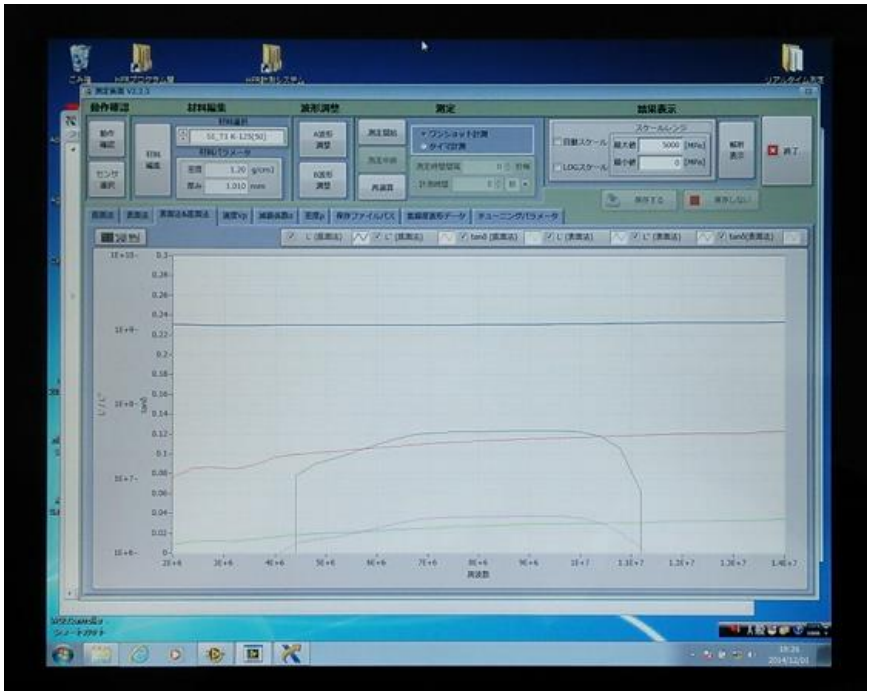
It is directly connected to the tire friction characteristics

- Ink evaluation

Features of the highfrequency viscoelasticity measurement apparatus HFR

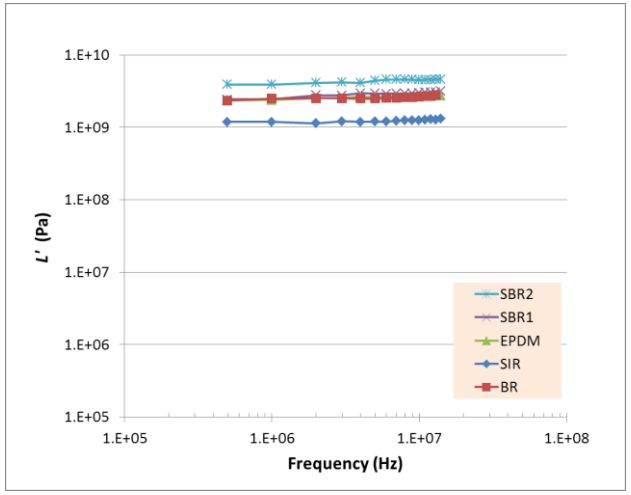
- Unnecessary calculation of troublesome ultrasonic measurement
- Viscoelastic measurement results display a spectrum
- The numeric data in Excel output
- It can also be measured of time-varying sample by Timer measurement

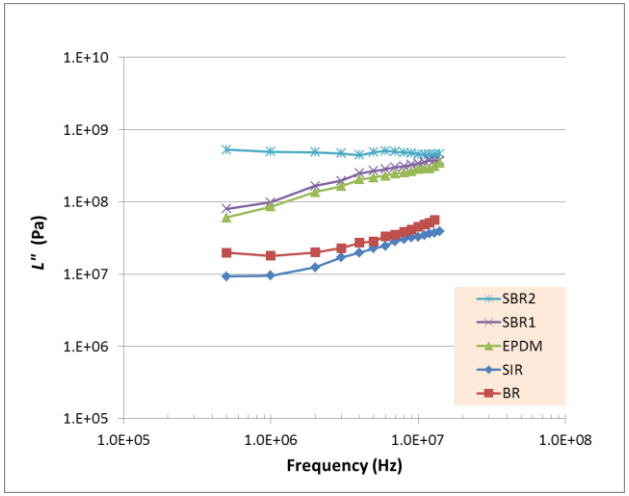
Measurement result display screen

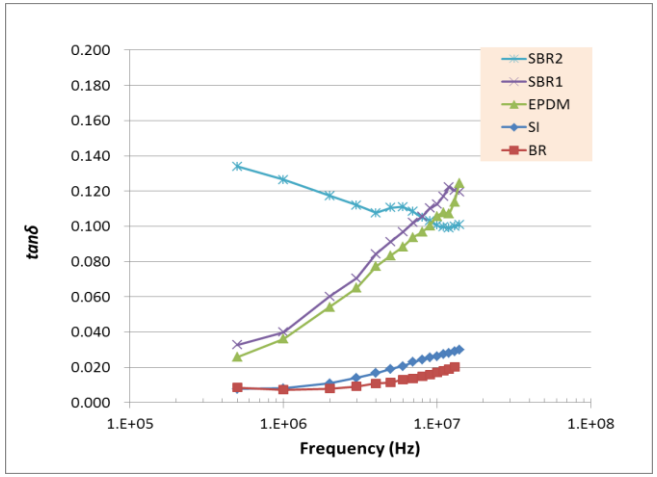


Sensors and sample

Measurement example of highfrequency viscoelastic properties of rubber





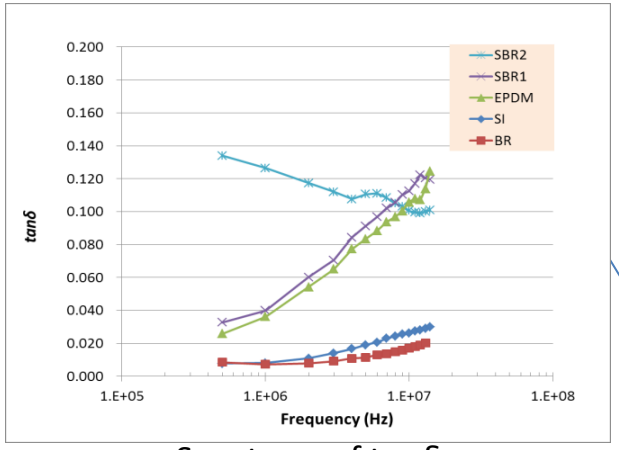


23℃

Correlation between a functional properties

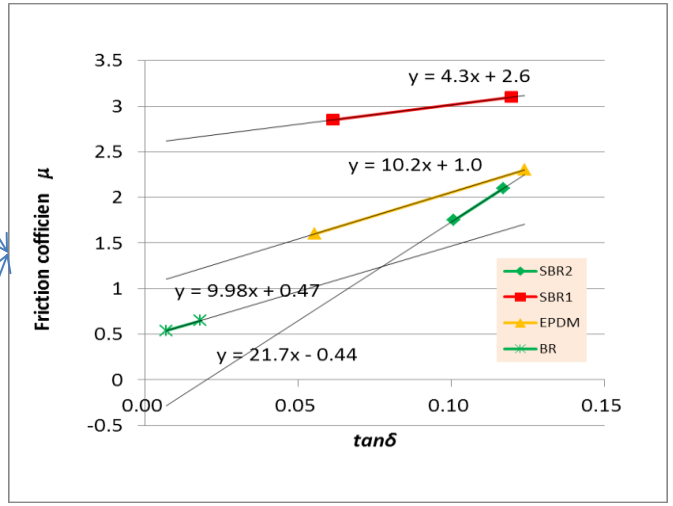
MHz band viscoelastic properties can be measured easily by using high frequency viscoelastic measurement apparatus HFR. So it became possible to study correlation between a functional properties (e.g. friction) and high frequency viscoelasticity in the actual operating temperature.

HFR



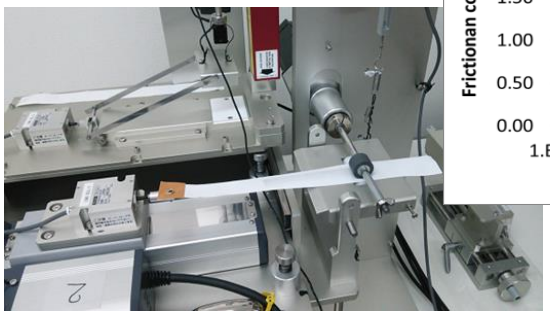
Spectrum of tanδ.

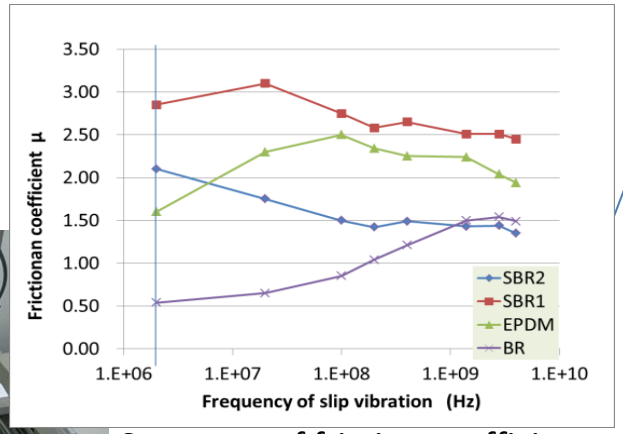
23℃



Correlation between tanδ and friction coefficient.

RRL





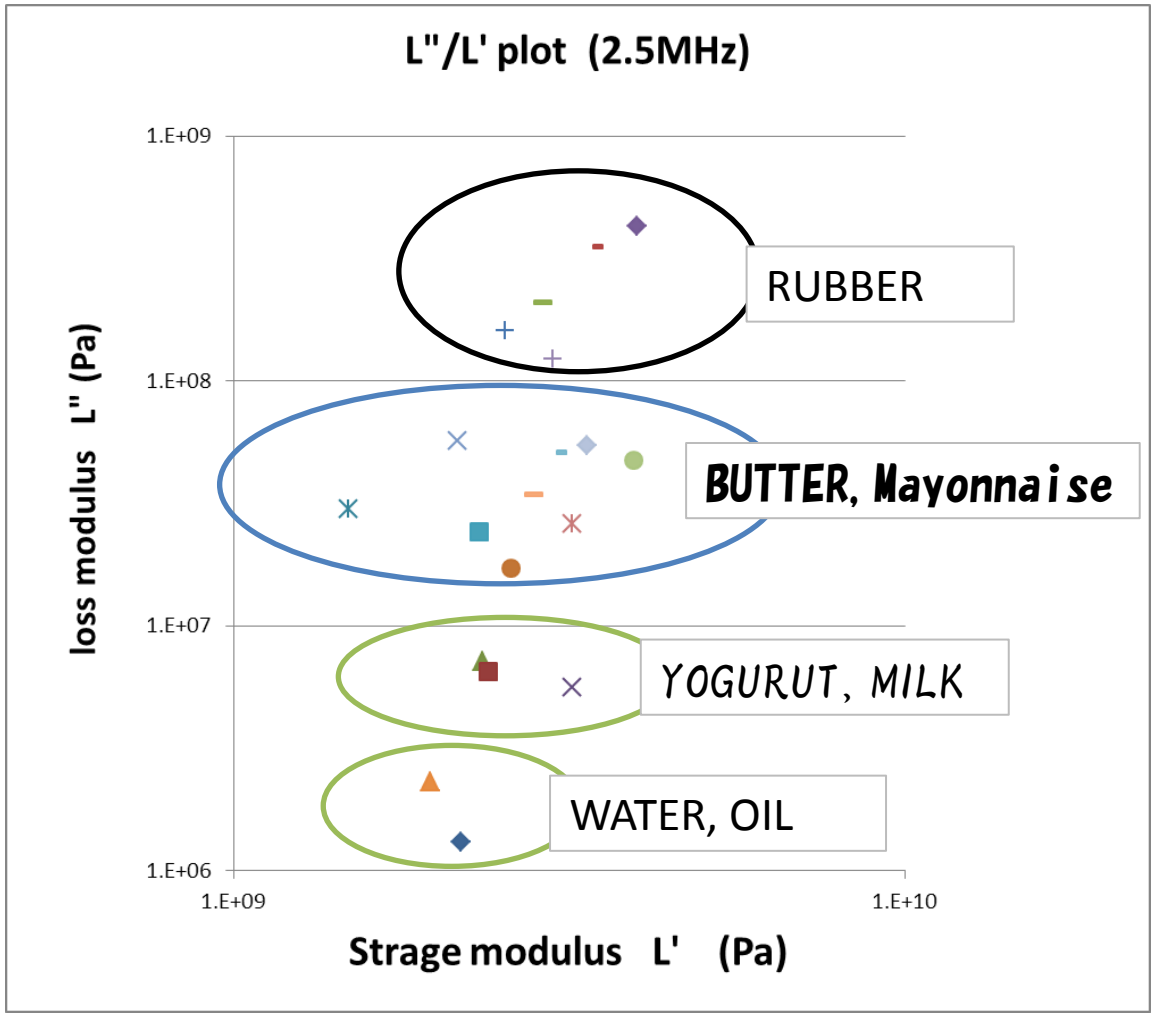
Spectrum of friction coefficient μ.

23℃

$$F = F_h + F_a = K \cdot E'^{-\frac{1}{3}} tan\delta + A \cdot s$$

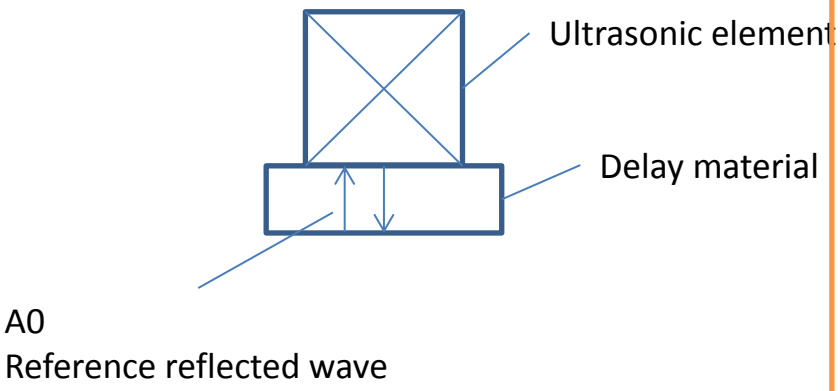
By amino, iwai, uchiyama

Measurement example of the highfrequency viscoelasticity of various materials

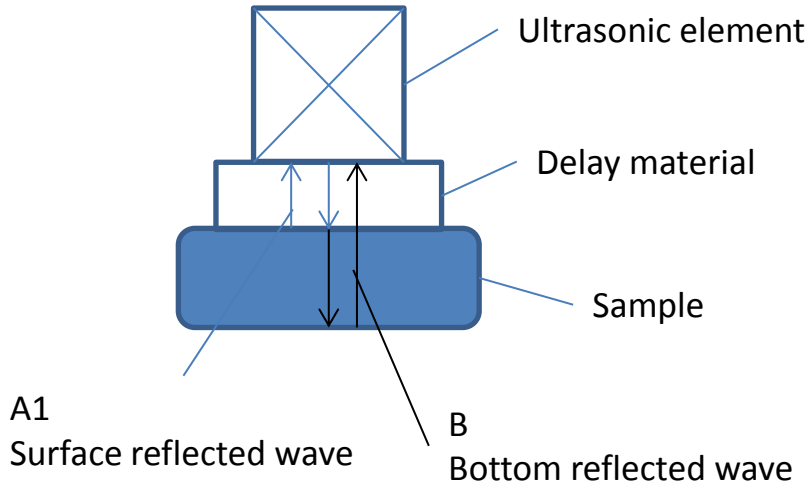


Waveform collection configuration

①You can absolute value measured by the reference waveform A0.
②And calculates the viscoelasticity by the surface reflected wave A1 and the bottom surface reflected wave B.
(Bottom method)
③It is also possible to calculate a viscoelastic alone the surface reflected wave A1.
(Surface method)



Reference waveform data collection



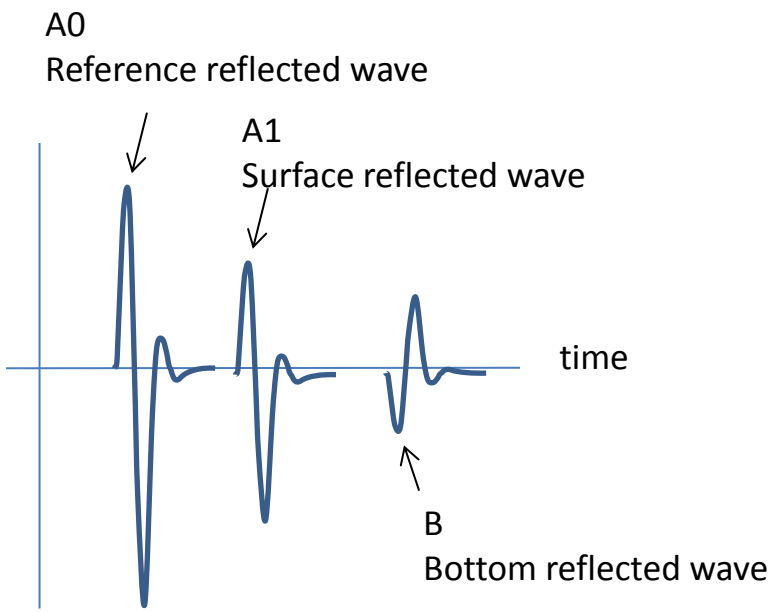
The measured waveform data collection

Viscoelastic spectrum formula

Each of the waveform FFT processing, acoustic properties (sound velocity Vp, the attenuation factor α, density ρ) by substituting the viscoelastic formula to calculate the complex modulus. (Bottom method)

$$L' = \rho V_p{}^2, \quad L'' = \frac{2\alpha\rho V_p{}^3}{\omega} = \frac{2\alpha V_p}{\omega} L'$$

$$\tan\delta = \frac{L''}{L'} = \frac{2\alpha V_p}{\omega}$$



Longitudinal waves elastic modulus	L=K+4G/3
Bulk modulus	K=L−4G/3
Young's modulus	E=9KG/(3K+G)
Shear modulus	G=3KE/(9K−E)
Poisson's ratio	ν =(3K−2G)/2(3K+G)

HFR type high frequency viscoelasticity evaluation apparatus

Specification

- Measuring frequency ：0.5～20MHz
  - ＊ Multiple sensors is required.
    Measurement bandwidth depends on the measurement sample
- Sample: solid, suspension, liquid　(there is attachment to each)
- Sample size ：
  Plane size : 50x50mm more
  Thickness of 1 to 10mm
  (depends on the measurement sample and measurement bandwidth)
  - ＊ Please consult parallelism and thickness accuracy that will be affected measurement accuracy in the solid
- Solid sensor size　WDH:300X300X500mm
- Controller size　WDH:700X900X1500mm
  - ＊ The high-precision measurement requires a constant temperature bath.
    (Inside dimension WDH: 600x700x900mm more)
- Weight: 135kg
- Power: 100V 1500w D species ground

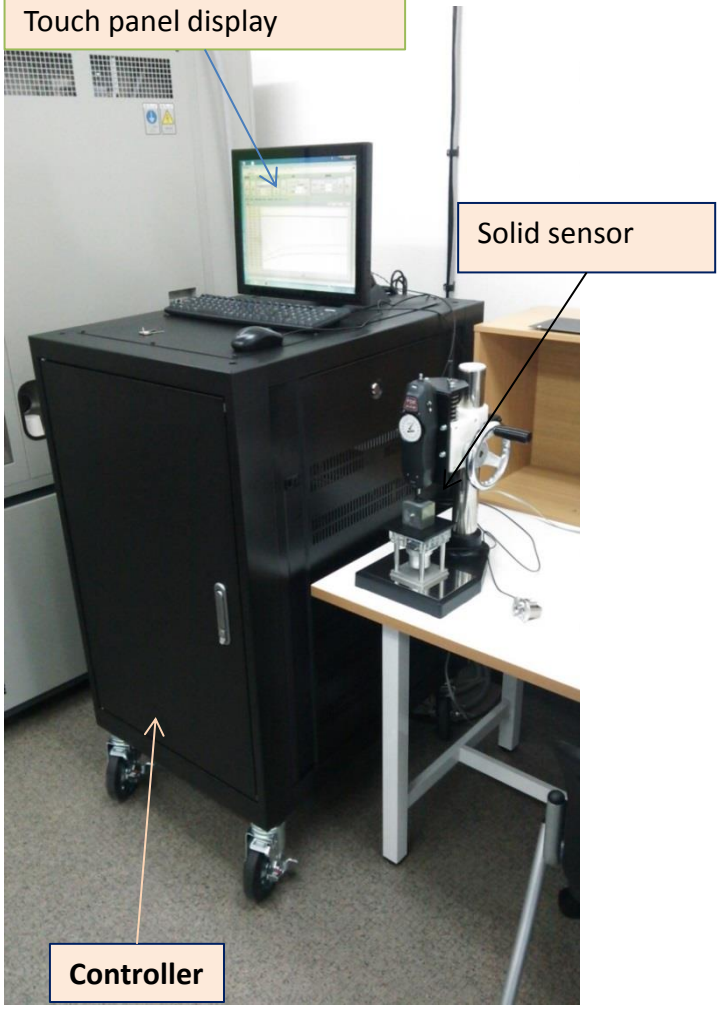
Development, manufacture and sales

Highfrequency Viscoelasticity Corporation

224-0007
Yokohama, Kanagawa Prefecture Tsuzuki-ku Edaminami 3-chome 1-21-102

http://www.highfrequency-viscoelasticity.com
info@highfrequency-viscoelasticity.com

Equipment full view



Since the specifications are subject to revision without notice for improvement,
Please contact me at the time of use is.2015.06.10