

Powerful Tool for Continuous Polymer Analysis with Great Cost Savings and High Reliability of Data

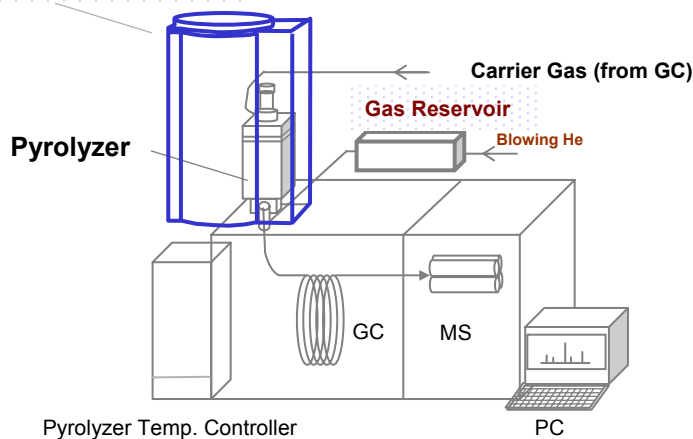
Designed for the Vertical Micro Furnace Type Pyrolyzer

(Single-Shot/ Double-Shot/ EGA/ Heart Cut EGA-GC modes)

Auto-Shot Sampler AS-1020E



Auto-Shot Sampler



**Typical Configuration of a GC/MS and Multi-Shot Pyrolyzer
EGA/PY-3030 Equipped with the Auto-Shot Sampler AS-1020E**

Features of Auto-Shot Sampler: AS-1020E

(Flash Pyrolysis/ Double-Shot Pyrolysis/ EGA/ EGA Heart-Cut GC modes)

Pyrolysis Gas Chromatography (Py-GC) is a very useful characterization of all kinds of polymeric materials including solvent-insoluble or composite materials. Py-GC is widely utilized in a spectrum of application areas such as polymer chemistry, quality control, forensic science, environmental field, energy related technology, geological science, or food chemistry.

Auto-Shot Sampler:AS-1020E was developed as accessory equipment to enable multiple sample analyses desired in such technical areas. This equipment provides sizable cost savings by reducing the workload and great improvement in the reliability of the analysis results when combined with the Multi-Shot Pyrolyzer EGA/PY-3030D of Frontier Laboratories Ltd.

Advantages of Automated Analysis

1. Great Cost Savings due to Reduction of Workload

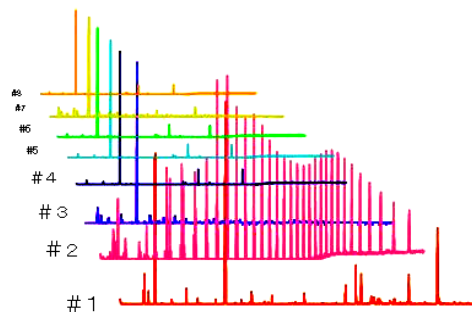
- **Continuous Operation possible for up to 48 samples**

Assuming the average time of obtaining a pyrogram to be an hour, analyzing 48 samples requires about one week. The equivalent result can be obtained in two days using the Auto-Shot sampler while the operator works on other tasks simultaneously.

- **Each sample analyzed by any of the four analytical methods**

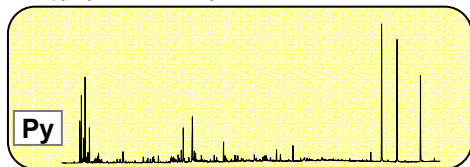
2. Significant Improvement of Reliability in the Analytical Results

- Variations due to operators minimized
- Variations due to unexpected factors such as sampling errors equalized

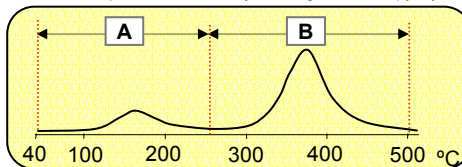


*** 4 Analytical methods Flash Pyrolysis/ Double-Shot Pyrolysis/ EGA/ EGA Heart-Cut GC**
Below figures are analysis of synthetic rubbers using 4 analytical methods)

1) Flash pyrolysis-GC (Py-GC) analysis
<Flash pyrolysis and GC analysis>

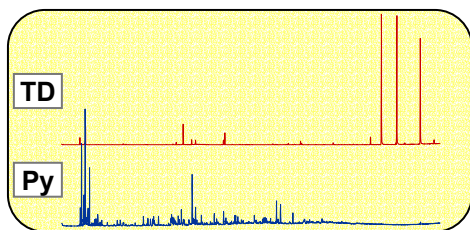


3) EGA analysis
< Powerful and simplified thermal analysis using Multi-Shot pyrolyzer>



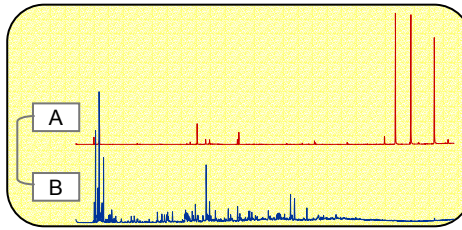
2) Double-Shot GC Analysis

<Thermal desorption for volatile analysis and then consecutive Py-GC analysis>



4) EGA Heart-Cut GC analysis

< GC analysis of a portion of selected range of thermogram obtained by EGA analysis>



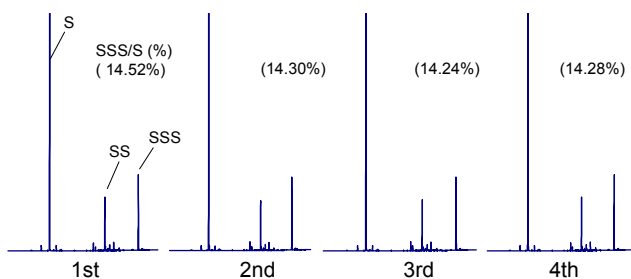
Guarantee High Data Reproducibility and Reliability of Analysis

Combination with "Multi-Shot Pyrolyzer®" Guarantees an Excellent Reproducibility

The Multi-Shot Pyrolyzer™ with a vertical furnace employs free-fall sample introduction and guarantees reproducibility of the analytical results. An example of pyrogram reproducibility when Auto-Shot Sampler was in use is shown in the figure below. The 48 samples of about 30 µg each of polystyrene were continuously analyzed. The average peak area ratio of styrene trimer versus styrene monomer thus obtained was 14.29%, and its reproducibility expressed by relative standard deviation (C. V. %) was 1.6%.

Reproducibility in Repeated Polystyrene Pyrolysis

Sample: Polystyrene, 30 µg, Pyrolysis at 530°C, Column Ultra ALLOY-5, 30m x 0.25mm id, 0.25µm GC Temperature 70- 320°C (20°C/min.), Detector: FID, S, SS, SSS: Styrene monomer, dimer and trimer

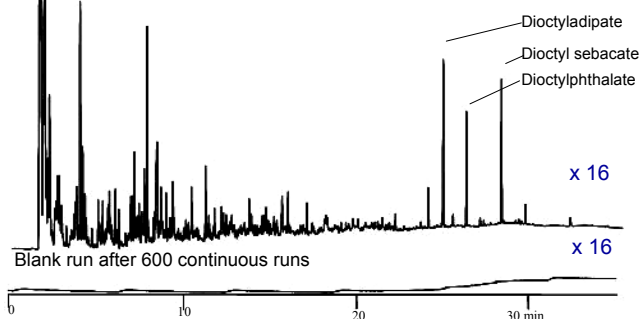


Evaluation of the Flow Path Contamination

In a continuous operation with multiple samples, high boiling point pyrolyzates may gradually deposit and disturb the analysis. In order to test the degree of such contamination, acrylonitrile-butadiene rubber (NBR) containing a few per cent of high boiling point plasticizers was subjected to 600 times continuous pyrolysis at 600°C. The charts below are the first pyrogram and the blank run (16 times magnification) after 600 pyrolysis runs. The plasticizers were not detected in the latter pyrogram even when the sensitivity of the FID was set at the highest.

Test for Flow Path Contamination

Sample: NBR (0.5mg), Pyrolysis at 600°C, Column Ultra ALLOY-5, 30m x 0.25mm id, 0.25µm, GC Temperature 40(3 min.)- 300°C (3min. hold)(10°C/min.)

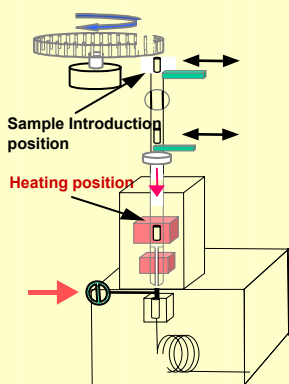


From Sample Introduction to Sample Cup Retrieval

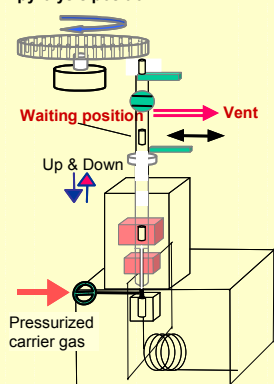
Sample cup introduction to the pyrolyzer: The sample cup is automatically introduced by gravity into the pyrolysis furnace through valves operating sequentially at each analysis cycle, and then heated according to the intended operation, such as thermal desorption, flash pyrolysis, or programmed raising of temperature. When heating is done stepwise, such as in the case of Double-Shot method or EGA-Heart-cut method, the sample cup travels up and down from the waiting position (ambient temperature) to the center of the heating furnace as the method specifies.

Sample cup retrieval after analysis : After the pyrolysis, the sample cup is blown up by the pressurized carrier gas introduced into the point between pyrolyzer and GC injection port. The cup is then retrieved into the receiver.

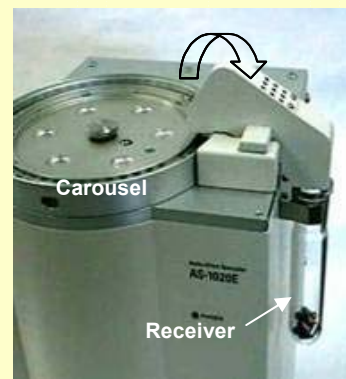
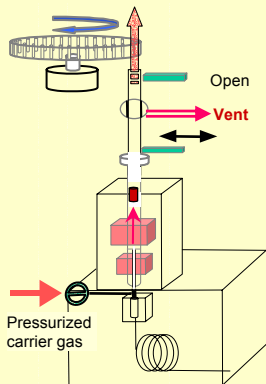
1. Sample introduction by free-fall



2. Sample cup movement by pressurized carrier gas and free-fall between waiting position and pyrolysis position



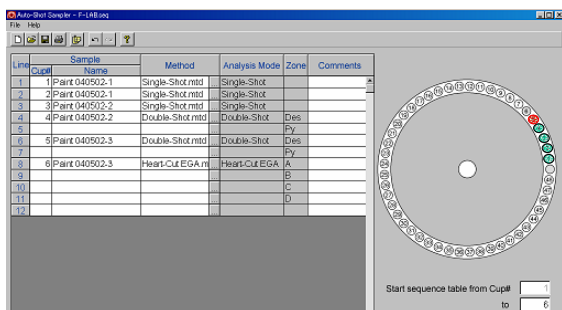
3. Sample cup retrieval by pressurized carrier gas



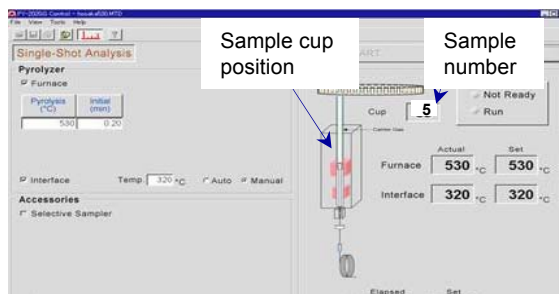
Sample cup retrieval

Comfortable Operation by PC control

Windows for Sequence Table and Auto-Shot Sampler Controls



A maximum of 48 sample cups can be set at one analysis operation. They may be analyzed either in sequence or at random. Setting up of the analytical conditions is done by registering sample name, method of analysis, and mode of analysis (Single-shot, etc.). The current status of analysis can be readily seen on the window on the left. The samples already analyzed are marked green, and the sample under analysis is marked red.



The operation of Auto-Shot Sampler is done by exclusive software that must be installed to your PC for controlling the GC. The chart on the left shows the window for controlling the operations of pyrolyzer and displaying the analysis conditions. When the analysis starts, the sample number currently being analyzed, position of the cup, and flow of the carrier gas are displayed real time.

Specification of Auto-Shot Sampler; AS-1020E

- Pyrolyzer: PY-3030D, PY-2020iD / iS (Frontier Laboratories Ltd.)
- Sample cup retrieving method: Blown-up method using pressurized carrier gas
- Number of sample cup: Max 48
- Sample Cup : Deactivated stainless steel cup (4 mm o.d., 8 mm H, 0.1 mm thickness, 80 μ L volume; sample max. amount is \sim 50 mg)
- Analytical mode: Single-Shot GC, Double-Shot GC, EGA and EGA Heart-cut GC analysis
- Control: Exclusive Software Installing PC of GC, GC/MS (Require a RS232C port for Auto-Shot sampler. Pyrolyzer also require one RS 232C port.)
- Compatible GC (GC/MS): Agilent 7890, 6890, Shimadzu GC-2010 and GC17 series, Thermo Fisher TRACE GC
- Dimension: 310 mm (H), 160 mm (W), 187 mm (D)
- Weight: 5.3kg
- Power Supply: AC100/110V, 50/60Hz, 60W max (Transformer: Option for 220/240V)

Auto-Shot Sampler
AS-1020E



Multi-Shot Pyrolyzer
EGAPY-3030D



Please forward your inquiries via our web page at: (<http://www.frontier-lab.com/>), or send us a fax message.

R&D and manufactured by:

Frontier Laboratories Ltd.

1-8-14, Saikon, Koriyama,
Fukushima, 963-8862 Japan

Phone: 81-24-935-5100 Fax: 81-24-935-5102