Multi-Shot Pyrolyzer®
EGA/PY-3030D

Flexible
Versatile
Reproducible
Why Evolved Gas Analysis?
Why Pyrolysis?

Today, analytical pyrolysis encompasses much more than simple flash pyrolysis of polymeric materials. Virtually any material (liquid or solid) can be characterized using an array of techniques, which are designed into a modern day, Multi-Functional Pyrolysis System. Consider how these techniques can help you quickly solve the most difficult analytical challenge:

Analytical Techniques:
- Evolved Gas Analysis (EGA)
- Pyrolysis (PY)
- Reactive Pyrolysis (RxPY)
- Multi-step Thermal Desorption (TD)
- Thermal Desorption followed by Pyrolysis (Double-Shot)
- Heart cuts based on the EGA thermogram
- UV Irradiation
- Conventional sorbent based thermal desorption
- High pressure, high temperature reaction chemistry

Examples of what can be done with a pyrolysis system, like the EGA/Py-3030D:

Thermal Desorption-GC/MS
- Phthalates in PVC
- Residual bisphenol A in polycarbonate
- Herbicides in wood pulp
- Volatiles formed during irradiation
- Hydrocarbon profiles of various shale oils
- High temperature fuel additives
- Outgassing of electronic components
- Outgassing of medical devices

Reactive Pyrolysis GC/MS - in less than one hour
- Fatty acids in a grain
- Fatty acids in a variety of biomass materials
- Fatty acids in cosmetics

Double-Shot GC/MS
- Additives in rubber
- Additives in paints, varnishes
- Contamination of disk drives

What's new from Frontier Laboratories?

Why are most laboratories integrating the Frontier Multi-Shot Pyrolyzer into their mainstream analytical protocols?

Guaranteed reproducibility and accuracy
Every facet of the system is designed to ensure reliability and data quality. All wetted surfaces are quartz, there is no transfer line, there is no cross contamination.

Versatility
The Pyrolyzer can be configured to analyze C2 vapors, C100 solids and everything in between.

Increase laboratory productivity
Sample prep takes less than five minutes; the low mass ceramic furnace heats and cools in record time.

Analyze any sample matrix
Virtually any material (gas, liquid or solid) can be chemically characterized.

Tools to help understand the data
F-Search software and four MS libraries utilize MS and GC data to simplify data interpretation.
Frontier Laboratories' new Multi-Shot Pyrolyzer EGA/PY-3030D is based upon the proven superiority of their patented vertical micro furnace, but everything else is new. A low mass ceramic heater heats and cools quickly. The needle interface has been re-designed to ensure thermal uniformity. The temperature control algorithm literally guarantees temperature reproducibility (±0.1°C) and the operating software has a number of new features. The concept is sound, the design is simple and the engineering first rate; a two year warranty is standard — from day one!

Two new samplers give the 3030D Pyrolyzer an even larger role in the analytical laboratory. Odors and other VOCs can be concentrated on conventional sorbents like Tenax and thermally desorbed using the TD Sampler. High pressure, high temperature chemistry can be investigated using the micro reactor sampler. Couple these two samplers with the many innovative accessories that can be added to the 3030D with the power of F-Search Software — you will agree that Frontier is all about analytical performance, versatility and capability.

Versatility: One instrument, multiple analytical techniques

The Pyrolyzer EGA/PY-3030D can be configured with five different samplers (shown) and other accessories. By simply changing the sampler, the 3030D can be used to make liquid injections, desorb sorbent tubes or SPME fibers, investigate reactions at high pressure and even monitor the volatiles released as a material is UV irradiated. There is a configuration for nearly every analytical challenge: from C2 to C100, literally ethane to Shale!

For more information see www.frontier-lab.com
Material characterization using the multi-mode capability of the Frontier Pyrolyzer EGA/PY-3030D

Abstract: When working with challenging samples, such as an eyeliner pencil, the first step is to characterize the sample using evolved gas analysis (EGA-MS). Analysis of the EGA thermogram provides information about the thermal complexity of the sample, the nature of the polymer and the presence or absence of specific compounds of interest. EGA will help the analyst select the next step in the process.

A good example of using EGA to suggest what analysis will yield the most useful information about the sample is the characterization of a commercial eyeliner. Like many cosmetics, eyeliner is a complex mixture of compounds ranging from volatiles to polymers.

The eyeliner is placed directly into the sample cup and analyzed directly; there is no sample prep.

Single-Shot analysis (PY-GC/MS)
The sample cup free-falls into the pyrolyzer furnace. The sample temperature goes from ambient to the pyrolysis temperature in less than 20msec. Pyrolysis occurs instantly and the pyrolyzates are introduced into a GC separation column.

The pyrogram of the eyeliner, shown below, was obtained at 550°C, which is 50°C higher than the temperature indicated by the EGA thermogram. The single-shot method is simple, however, the pyrogram represents the degradation of all organics in the sample which sometimes makes it difficult to interpret.

Double-Shot analysis (TD/PY-GC/MS)
Double-shot analysis provides information about the volatile constituents and the polymeric content of the sample. The eyeliner is analyzed in two steps. STEP 1: volatiles evolving from the sample are analyzed by thermal desorption (TD)-GC/MS. This process results in a total ion chromatogram which can be used to identify the individual compounds in the sample.

The total ion chromatogram shown below includes that portion of the sample (peaks A, B, and C) that evolves between 100 and 300°C. A MicroJet Cryo-Trap is used to focus the individual compounds during the desorption interval at the head of the column. This maintains peak fidelity and column resolution.

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Heart-cut analysis (EGA-GC/MS)
Vapors evolving from each EGA thermal zone are selectively introduced into the GC separation column and analyzed by GC/MS. Using the selective sampler and the MicroJet Cryo-Trap up to eight thermal zones can be isolated and analyzed.

Shown below are the chromatograms obtained when each of the EGA thermal zones (A – E) is analyzed sequentially. The entire method can be automated using the auto-shot sampler.

Qualitative and quantitative analysis based on data from varied sources including F-Search and other analytical techniques

- Identification of volatiles (A, B, C): F-Search (EGA and additives) / NIST, Wiley library
- Identification of volatiles (D, E) originated from polymer: F-Search (polymer and pyrolyzates libraries)
- Identification of volatiles (A, B, C, D, E): user generated library
3030D Accessories for extended capability

**Micro-UV Irradiator (UV-1047Xe)**
Any polymeric material can be exposed to UV radiation, in any atmosphere, at temperature, for virtually any length of time. Volatiles formed during the irradiation are trapped and analyzed.
Technical Notes: PYA5-003E, PYA5-001E

**Auto-Shot**

**EGA/PY-3030D**

**Carrier Gas Selector (CGS-1050Ex)**
Automatically switches between two different gases. Heat sample in air, separate using helium.
Technical Notes: PYT-23E, 24E and PYA4-003.

**Selective Sampler (SS-1010E)**
Heart-cut individual EGA thermal zones. Each zone can be directed to the analytical column for analysis or automatically vented.
Technical Notes: PYA-012E, 019E and 023E

**MicroJet Cryo-Trap (MJT-1035E)**
Technical Note: PYT-019E

**GC/MS Adapter (MS402180)**
The Vent-free adapter facilitates changing columns or the change over from EGA to the analytical mode without venting the MS.

**Ultra ALLOY Metal Capillary Columns**
Available with a number of high temperature stationary phase, column lengths, film thickness and column inner diameters. Multi-layer deactivation treatment enhances thermal stability, inertness and durability.
Technical Notes: UAT-002E, 003R and 004E

**Auto-Shot Sampler (AS-1020E)**

Up to 48 samples can be analyzed. When performing multiple analyses on a single sample, the sample is held at near-ambient temperature between analyses. The sample path has one isolation valve and two magnetic cup positioning valves which are always at ambient temperature.

The automated analysis of multiple samples requiring different analytical modes can be analyzed in a single sequence. Evolved gas analysis (EGA), which is done with a tube rather than a separating column, requires a separate sequence table.

**Table:**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Method</th>
<th>Analysis Mode</th>
<th>Zone</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Single SS mtd</td>
<td>Single Shot</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Single SS mtd</td>
<td>Double Shot</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>Single SS mtd</td>
<td>Single Shot</td>
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</tr>
<tr>
<td>4</td>
<td>Double DS mtd</td>
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<td>C</td>
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<td>Sample2</td>
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<td>6</td>
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<td>7</td>
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<tr>
<td>14</td>
<td>Sample11</td>
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**MicroJet Cryo-Trap**
Technical Note: PYT-019E

**G-Search**

**Auto-Shot**
EGA/PY-3030D

**F-Search**

**Auto-Shot**
EGA/PY-3030D

**MicroJet Cryo-Trap**
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<td>Single Shot</td>
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<td>Sample12</td>
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<td>Single Shot</td>
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guaranteed reproducibility
F-Search is used to identify individual compounds and/or polymers using a patented search algorithm and specialized Frontier MS libraries. The libraries include GC as well as MS chromatograms. Each library can be edited. In addition, custom in-house libraries can be created. Four libraries are available: polymer, pyrolyzates, additives and EGA thermograms.

The GC/MS data obtained with the instruments manufactured by Agilent Technologies, Shimadzu, and JEOL can be searched without modification. Data generated on GC/MS instruments manufactured by other companies can also be searched after converting the data file to a NetCDF (AIA).

If your system includes the NIST/EPA/NIH mass spectral library (National Institute of Standards and Technology) and its search engine software, it can be accessed directly from within F-Search.

The partial results for a typical library search are illustrated below.

The average MS spectrum of the unknown along with the averaged spectrum of the two best matches are shown. A table showing match quality is presented.
Compatibility & Support

The EGA/PY-3030D Multi-Shot Pyrolyzer is compatible with major manufacturer’s GC or GC/MS systems.

All Frontier channel partners receive periodic service training on all Frontier Lab products. This ensures that our customers receive quality support worldwide.

Visit our website to view a number of support videos including maintenance and F-Search demonstration.