# Application Note 98

## Diversity of Applications of the GeoPyc 1360

The GeoPyc® 1360 measures the envelope density (sometimes called bulk density) of rigid and semi-rigid, porous materials. Unlike absolute density, which excludes the volume of pores and small crevices, envelope density is the mass of an object divided by its volume including the pore volume. When the sample's absolute density (sometimes called skeletal, true, or real density) is supplied, the GeoPyc automatically calculates the sample's percentage total porosity and specific pore volume. (Absolute density can be obtained using Micromeritics' AccuPyc™ 1330.)

The GeoPyc uses a dry-fluid medium — called Dry*Flo*® — to measure the sample's volumetric displacement. Because Dry*Flo* conforms to sample surfaces without entering pores, irregularly-shaped samples and even samples comprised of multiple objects can be analyzed.

Unlike other methods, such as mercury intrusion and hot-wax dipping, the GeoPyc 1360 method is generally non-destructive of the sample, rapid, easy to perform and involves no handling or disposal of hazardous materials.

The GeoPyc completes density analysis and automatically prints a report in 5 to 20 minutes, depending on user-selected parameters. This rapid sample turnaround makes the GeoPyc an ideal quality control tool for many industries. Reducing analysis time and/or analyzing a larger percentage of samples means that production can respond more effectively to quality standards, whether the goal is to maximize the porosity of catalyst substrate or to minimize the porosity of powdered metal objects.

The GeoPyc could be most useful, however, when a constant level of product porosity must be maintained within narrow specifications. The GeoPyc's method facilitates quick identification and correction of changes in product porosity. The simple technique and fully-automated process are designed to minimize human error.

The GeoPyc is also convenient for most labs because it is quiet and compact, and requires only an electrical supply (no gases or liquids).

A variety of materials ranging from highly porous to nonporous can be analyzed. A sampling of materials with typical results is shown in Table 1.

The tests giving these results were performed on prototype instruments to demonstrate the GeoPyc's capability. The tabulated information is believed to fairly represent the great range of applicability and utility of the GeoPyc 1360.

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*Table 1.Typical Results*

| Sample Identification | Envelope Density ($g/cm^3$) | Porosity (%) | Specific Pore Volume ($cm^3/g$) |
|---|---|---|---|
| Stone Fragments | 2.469 | 9.39 | 0.038 |
| Stone Fragments | 2.096 | 21.54 | 0.103 |
| Stone Fragments | 2.562 | 5.35 | 0.021 |
| Polyethylene Foam | 0.032 | 94.10 | 28.98 |
| Copper Chromite Catalyst | 1.985 | 52.03 | 0.262 |
| Copper Chromite Catalyst | 1.497 | 62.25 | 0.416 |
| Powdered Metal Bronze Bearing | 7.012 | 15.81 | 0.023 |
| Carbonized Fabric | 1.374 | 14.99 | 0.100 |
| Cast Refractory | 2.894 | 22.24 | 0.080 |
| Fired Ceramic | 1.947 | 28.77 | 0.148 |
| Clay Brick | 2.251 | 13.09 | 0.058 |
| Sintered Metal Part | 5.384 | 28.92 | 0.054 |
| Porous Plastic | 0.552 | 41.08 | 0.744 |
| Alumina Abrasive | 3.592 | 8.05 | 0.022 |
| Silica Cracking Catalyst | 1.099 | 48.59 | 0.442 |
| Clay Extrudate, Unfired | 1.897 | 28.77 | 0.152 |
| Clay Extrudate, Fired | 2.279 | 5.66 | 0.025 |
| Geologic Formation | 2.514 | 6.91 | 0.027 |
| Geologic Formation | 2.702 | 0.72 | 0.003 |
| Alumina Catalyst Substrate | 1.053 | 66.85 | 0.625 |
| Aerogel | 0.146 | 93.04 | 6.386 |
| Nylon Molding Resin | 1.103 | 2.90 | 0.026 |
| Compacted Sodium Chloride | 2.103 | 2.34 | 0.011 |
| Powdered Metal Spur Gear | 6.953 | 10.97 | 0.016 |
| Resin-Carbon Fiber Composite | 1.497 | 3.68 | 0.025 |
| Bauxite Granules | 3.343 | 6.09 | 0.018 |
| Periclase (Mg0) Granules | 3.382 | 2.33 | 0.007 |
| Activated Carbon | 0.646 | 68.06 | 1.053 |
| Ferrite | 3.938 | 46.12 | 0.117 |
| Ceramic Granulate (Red) | 1.944 | 28.87 | 0.148 |
| Clay Tile | 2.491 | 0.132 | 0.001 |
| Resistor Ceramic | 3.733 | 1.500 | 0.004 |
| Rock Core | 2.362 | 13.10 | 0.055 |
| Rock Core | 2.080 | 21.78 | 0.105 |
| Space Shuttle Tile | 0.230 | 89.90 | 3.902 |
| Tantalum Anode | 8.284 | 42.74 | 0.052 |
| Pelletized Iron Oxide | 3.732 | 19.88 | 0.053 |
| Sintered Carbon Shape | 1.275 | 19.92 | 0.156 |
| Sintered Bronze | 7.300 | 14.71 | 0.020 |
| Ferrite (Green) | 2.850 | 42.01 | 0.147 |
| Milk Sugar - Cellulose Pellets | 0.815 | 41.11 | 0.504 |
| Pharmaceutical Tablets | 1.185 | 33.06 | 0.279 |