VINCI TECHNOLOGIES
Laboratory and field instruments for Petroleum Industry

ABAT - Air Jet / Fluidized Bed Attrition Tester

Determination of the relative attrition characteristics of powdered catalysts by means of air jet attrition
Designed in full compliance with ASTM D5757

The ABAT – Air Jet / Fluidized Bed Attrition Tester – is designed in full compliance with ASTM D5757, which specifies the determination of the relative attrition characteristics of powdered catalysts by means of air jet attrition. This method is primarily intended for fluid catalytic cracking (FCC) catalysts, whether fresh or steamed, and applies to spherically or irregularly shaped particles with a size range typically between 10 and 180 microns. The test evaluates the resistance of catalyst particles to degradation under fluidization conditions that simulate industrial reactor environments. The result of the test is expressed as the Air Jet Attrition Index (AJI), defined as the percentage by weight of fines smaller than 20 microns generated after five hours of controlled fluidization.

The principle of ASTM D5757 is based on subjecting a humidified catalyst sample to high-velocity air jets within a vertical attrition tube. The controlled air stream fluidizes the powder bed, inducing inter-particle collisions and surface abrasion. Fine particles generated during the test are carried upward by the airflow into a disengagement section where separation occurs. The larger catalyst particles fall back into the attrition tube, while the fines are transported to a dedicated collection system. This dynamic fluidization mechanism reproduces the mechanical stresses encountered in circulating fluidized bed reactors.

VINCI TECHNOLOGIES Parc de l'Ile, 27B rue du Port, 92022 NANTERRE
Phone: +33 1 41 37 92 20 - vincinet@vinci-technologies.com - http://www.vinci-technologies.com

The apparatus consists of three main sections designed according to ASTM dimensional and operational requirements. The air supply system delivers a regulated airflow at 0.5 kg/cm² gauge pressure with approximately 35 percent relative humidity, obtained by bubbling air through a 25 cm water column at room temperature. The attrition–disengagement section comprises a vertical attrition tube fed at its base by air passing through three precision sapphire nozzles, selected for their hardness and dimensional stability as required by the standard. Above this tube, a disengaging section with a diameter three times larger enables efficient separation of catalyst particles from generated fines. The fines collection section incorporates a dedicated filtering collector followed by a wet gas meter that measures and verifies the airflow rate. The equipment sizing and geometry strictly comply with ASTM D5757 specifications to ensure reproducibility of results.

Sample preparation is critical to test accuracy. A representative composite sample is first reduced by riffling or splitting to obtain approximately 65 grams, which is then screened through a No. 80 ASTM sieve with 180-micron openings to remove oversized particles. The catalyst is humidified to reach a moisture content between 30 and 40 percent, using procedures adapted to fresh or equilibrated FCC catalysts. From this prepared material, 50 grams of water-equilibrated sample are used for the test.

Before testing, the apparatus is thoroughly cleaned and assembled, except for the fines collector. The airflow is adjusted to approximately 600 liters per hour at 0.5 kg/cm² gauge pressure with controlled humidity. Two conditioned fines collectors are prepared by exposing their filters to humidified airflow for stabilization, then weighed and stored prior to use. During the test, the 50-gram sample is introduced through the top of the disengager, and the first collector is installed. After one hour of fluidization, the collector is replaced with a second one, and the test continues for an additional four hours, making a total duration of five hours. Each collector is weighed immediately after removal. At the end of the experiment, the attrition section is dismantled, the remaining catalyst in the attrition tube and disengager is recovered and weighed, and the system is cleaned.

The fines generated during the first hour are calculated as the mass increase of the first collector divided by the initial sample mass. The total Air Jet Attrition Index (AJI) is calculated from the combined mass of fines collected over five hours divided by the initial sample mass, expressed as a weight percentage. A recovery ratio is also determined by accounting for the mass of recovered catalyst and collected fines relative to the original sample mass, ensuring material balance consistency.

The equipment has approximate dimensions of 760 × 980 × 2000 mm and a weight of about 70 kg, making it suitable for dedicated catalyst testing laboratories and refinery research centers. In its semi-automated configuration, the ABAT is equipped with an integrated automation system that monitors, regulates, and records key parameters including upstream and downstream pressure, temperature, airflow rate, humidity, experiment duration, and sample mass via an external balance. Control is performed through a PLC coupled with a Human Machine Interface, providing real-time visualization of operating conditions, remaining test time, and recorded results. This configuration enhances operational reliability, ensures strict compliance with ASTM D5757 requirements, and improves traceability and data integrity in routine quality control and research applications.