Acid Digest

4-Acid digest process is used for elemental analysis of ores. The use of the four acids, Hydrochloric, Nitric, Perchloric and Hydrofluoric acids provide the ability to dissolve almost any compound which is likely to be found in any naturally occurring ore. These four acids are extremely dangerous but through the use of robotics and automation technologies the risk to personnel can be greatly reduced. Robotic Acid Digestion systems: Accept soil samples.Perform a sequence of chemical additions, weighing, heating, cooling, mixing & cleaning actions which comprise the acid digest.Output liquid samples ready for elemental analysis.Can be linked to analysis machines e.g. ICP-OES, ICP-MS, Flame AAS etc. Robotic systems such as this one have much greater sample processing rates in comparison to the old way using human processing. Robots are not limited to set working hours, they do not experience much downtime, they have the ability to work 24 hours a day 7 days a week.

Technical Info: Detailed description of Chemistry Underlying a 4-Acid Digest The 4-acid digest process is a digestion process which is utilised in analytical laboratories performing analyses for customers in the mining and minerals industry. The 4-acid digest is used to dissolve soil samples to perform multi-element analysis. The four acids used include: Hydrochloric Acid (HCl), Nitric Acid (HNO3), Perchloric Acid (HClO4) and Hydrofluoric Acid (HF). The combination of these four acids will dissolve most compounds found in soils. Hence the ability of these acids to digest every component of soils and put it into solution means that multi-element analysis can be utilised to great accuracy. A typical process of a 4-acid digest proceeds with the addition of the acids, firstly nitric and perchloric acids are premixed in a 3:1 ratio respectively and added, followed by the addition of hydrochloric acid and followed by the addition of hydrofluoric acid. The solution is then allowed to stand at room temperature for a short time before being moved between two heating mantles set at different temperatures. The movement of the solution between these two heating mantles is performed as to allow certain reactions to occur in a specific order. Initially the solution is placed onto a heating mantle of lower heat, this allows all reactions requiring less energy to initiate and the movement onto the heating mantle of greater heat allows for the more stable components of the soil to become more reactive and also for some of the volatile gases produced to be boiled off. Once heated for the appropriate time, the solution is allowed to cool prior to a second dosing with hydrochloric acid. This second dosing of hydrochloric acid is required as often after the initial heating the solution is taken to dryness (Note: it is best not to take it to dryness as you my lose the lighter molecular weight elements, it is best to take the solution to incipient dryness), and the residue left on the container requires re-dissolution, which is more easily accomplished with an acidic solution. After addition of the acid the solution is once again placed onto a heating mantle which aids in the re-dissolution of the residue. Once all the soil is in solution it becomes a matter of making the solution up to a set volume and making the solution homogeneous. This is done so that the elemental proportions gathered from the detectors on the analysis machinery are able to be converted back to find out the elemental proportions of each element with the initial soil sample. Analysis Instrumentation: Once the solution is made up and is homogeneous, the solution is analysed for all elements of interest by high tech instrumentation. Some of the high tech instrumentation used include Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), Flame Atomic Absorption Spectroscopy (Flame-AAS), Inductively Coupled Plasma Mass Spectrometry (ICP-MS). These instruments have the ability to detect elements to a concentration of parts per million (ppm) or parts per billion (ppb) depending on sensitivity and the instrument. Robotics in the Laboratory: Most analytical laboratories perform these analyses by hand which exposes staff to harmful acids as well as repetitive boring work. However in recent years, developments in technology have arisen in the field of robotics and automation, and many labs are now converting their systems toward automation. Laboratories around the globe are turning their sights to robotics and automation due to the ability to increase efficiency and reproducibility for sample analysis. Robots provide a means to deliver accurate, repeatable results with minimal time wastage as well as minimal materials wastage. Due to the ability of robots to be precisely programmed and their ability to follow complex algorithms, heating times and process times are able to be optimised according to requirements of specific samples. Through the use of robots and simple automation, it is easy to perform many laboratory processes. Especially processes which mainly involve pick/place, dosing, weighing, heating, cooling, sample transfer and mixing actions, which covers most laboratory procedures.

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