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Computer Aided Design And Analysis of Volatile Separating Device

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Abstract

Volatiles in the current context are molecules with boiling point up to 200°C. Conventional methods for separating volatiles are biased towards one of the physical or chemical properties of the molecule and hence are not complete. So volatiles separated from the mother matrix will contain fewer molecules and even the most precise instruments can resolve only fewer molecules. On the other hand a better sampling device utilizing thermal desorption, kinetic desorption, solubility in steam, desorption by microwave, desorption by magnetic induction or laser can separate larger number of molecules and hence can enhance the efficiency of instruments like MS. A sampler using thermo-kinetic desorption was fabricated in house and comparative study was conducted against conventional techniques. A 25 percent increase in peaks was observed when analysed with GC. The possibility of thermal decomposition was ruled out by conducting GC- MS studies.

The aim of the current study is to develop a highly precise sampling device with global standards and has wide applications in the field of aromatic, analytical, biological and medical fields.

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1. INTRODUCTION

This Report describes a new design approach that came from a volatile separation technology. The conventional methods, separated volatiles from materials from Organic matters are biased to any single physico-chemical properties of the volatile and are efficient to separate low boiling fractions only. The goal of this new design approach is to

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provide better heating and cooling modes, Equipment, maintaining of inert atmosphere in envelope, well stabilized desorption-adsorption process for volatiles from the provided organic matter.

Volatile is a substance which can change state from a solid or liquid to vapour. Gas chromatography (GC) is the instrument used to study volatiles and it can analyse molecules whose boiling points are as high as 250°C or more. But it is necessary to make sure that Non-volatile material should not enter into the GC column. So there is a requirement of a safe sampling device for GC. Sampling device is separator unit, which will extract the molecules or volatiles from the given sample.

The Prototype device for this is already manufactured, which is a POC (Proof of Concept). The goal of this report is to reduce the size of complete equipment, modular design. For the purpose of heating the envelope electrical heaters are used with sensor for establishment of feedback control system. Also for cooling the purpose electric cooling chip are used, which works on peltier effect.

This report also analyses influence of the internal geometry design over flow path of nitrogen gas and turbulence created by pressurized nitrogen gas, with the help of CFD software.

2. Literature Review

Following literature describes the prototype of Volatile Extraction Device developed previously. This device works on thermo-Kinetic Principle of extraction. The equipment contains following parts^[4]:

1. PID Controller.
2. Electrical Circuit.
3. Flow and Temperature control.
4. Desorptor and Condenser.
5. Absorbent.
6. Heating and cooling Media.
7. Critical components of the system are design and geometry of Desorptor and Condenser, selection of heating and cooling media, absorbent material, and feedback control system for governing temperature, flow and Pressure.

2.1. Working

A solid or semisolid sample containing volatiles is heated using multiple sources in a current of dry or moist (controlled) Nitrogen and the effluents are driven to a frigid cartridge pre-loaded with appropriate adsorbent. Once the adsorption is complete, the cartridge can be flash heated and the pneumatics drive the volatiles through appropriate membrane filters to the GC for analysis. Membrane filters are used to selectively detain water molecules and molecules of particular choice. Fig.1 shows the typical layout of existing system.

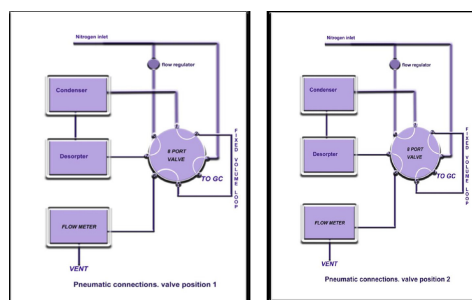


Fig. 1. Typical Layout of Existing System.^[4]

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