Section 4.5.5 VSP

4.5.5 Vent Sizing Package (VSP)

This calorimeter was developed in the frame of the DIERS project (Design Institute for Emergency Relief Systems) in the eighties [10]. Its working principle is similar to the ARC presented in the previous section, but it has some special features. It is a so-called low Phi calorimeter, meaning that its thermal inertia factor (Φ-factor) is close to 1: usually 1.05 to 1.15. Thus, it requires less intensive corrections of the measured temperature and pressure data. This low thermal inertia factor is obtained by using a larger volume of reactants, approximately 80 ml, in a thin-walled metal test cell (can) with the drawback of a poor pressure resistance. This is compensated for by placing the test cell in an autoclave equipped with a pressure controller, maintaining the pressure difference between the test cell contents and the autoclave below a predefined value by controlling the pressure in the autoclave with nitrogen injections (Figure 4.23). Adiabatic conditions within the test cell are maintained by using a "guard heater" to keep the surrounding temperature equal to the sample temperature: it is an active "thermal insulation" as in the ARC. Thus, this calorimeter has two tracking functions: the temperature and the pressure. Moreover, the test cell is equipped with a magnetic agitator, allowing the operator to perform reactions under conditions close to industrial processes, while allowing for an experimental simulation of a runaway.

The test cell and test method are highly customizable. The test cell can be constructed stainless steel or Hastelloy C and can also be glass lined. Glass lined test cells result in an increase of the Φ–factor. Test cell designs can include wall baffles, dip tubes, multiple thermocouples, scaled vents, and other features to help simulate a process upset.

The autoclave is closed for standard experiments, but may also be opened by a valve, allowing for pressure relief simulation and determination of foaming (flow regime) properties or the determination of the amount of liquid, vapor, or gas discharged. This calorimeter is basically a small chemical reactor but is specially designed to provide directly scalable calorimetric data in the context of vent sizing and emergency relief system design: these aspects are developed in Chapter 16.

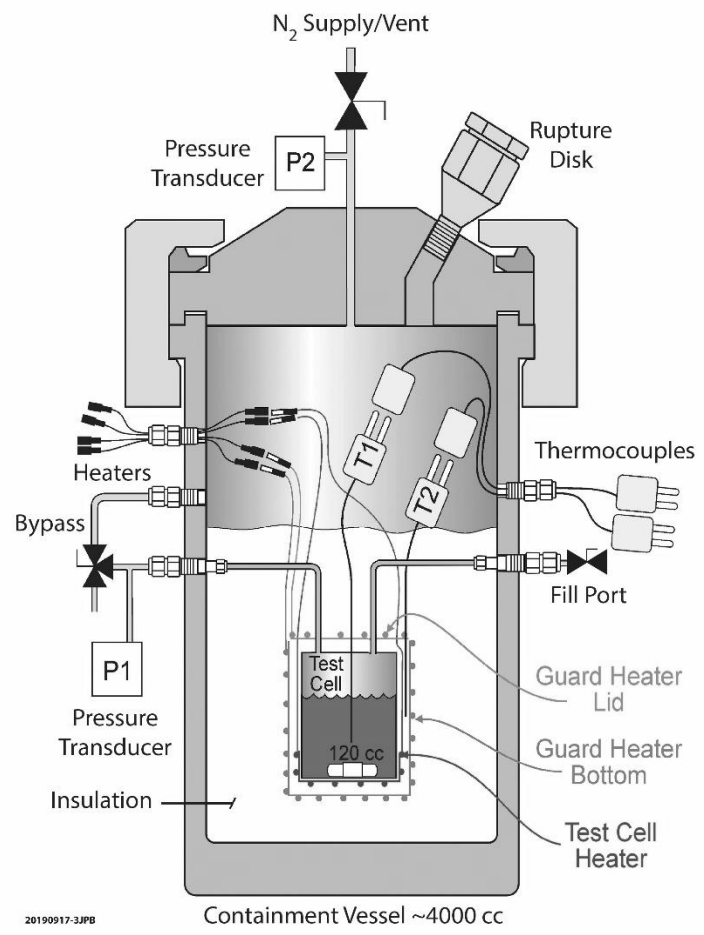

Fig. 4.23 Working principle of the VSP2, used with permission of Fauske &Associates LLC.