Energy Recovery and Separation

Energent is developing energy recovery technology in cryogenic and other industrial processes having two-phase Joule-Thomson valves . The Variable Phase Turbine technology, as it is known, is also being applied to recover waste heat and to produce geothermal power, two forms of Green Energy . In most of these processes involving liquid and gas, separation is required.

Conventional gravity separators, while reliable, can have several drawbacks. Foremost among these are size, weight and cost. For example, a typical offshore production separator string was reported to weigh ~670 tons and to require a footprint of ~270 square meters . Another commonly recurring problem is generation of foam, limiting the production flow rate, known as “bottle necking”. Air separation, LNG production and other refrigeration processes all require gas-liquid separators.

LABORATORY BIPHASE TURBINE

Figure 1 Separating Two-Phase Turbine Operating in Laboratory

Energent has a unique technology known as the Separating Variable Phase Turbine (“SVPT”) that combines energy recovery with compact, high “G” separation. This technology when applied to the combination of a two-phase Joule-Thomson valve and gravity separator can reduce the weight and footprint by a factor of 10 or more while generating power in a single compact device. For example, the study quoted, ibid 3, found that application of this technology reduced the weight and footprint of the separation string by a factor of more than 10 while generating power from the flashing liquid flows equivalent to that of a large gas turbine.

The basic principle of the SVPT is illustrated in figure 1, an early unit operated in the laboratory. A high pressure two-phase mixture is accelerated in a two-phase nozzle. The nozzle is contoured to produce a near isentropic expansion from high pressure to the letdown pressure. The two-phase jet formed is directed onto a rotating cylinder. The centrifugal forces resulting from the rotation cause a clean separation of gas and liquid. The separated liquid, as can be seen, forms a protective layer on the rotating cylinder, shielding the surface from any erosion. The high velocity jet and rotating liquid layer transfer energy to the rotating separator structure which may also have blading means (not shown). The shaft can drive a generator, producing power.

As shown, there is absolutely no liquid carryover in the gas. The laboratory unit was rotated by the action of the two-phase jet at a speed of 10,000 rpm resulting in a centrifugal separating force of 17,000 “G’s”. The separated liquid has no entrained gas. The photograph shows perfectly transparent liquid entering the scoop. The scoop can be contoured to recover the dynamic head as pressure to pump the separated liquid without an external pump. The “scrubbing” action of the two-phase jet keeps the surface free of any scale deposits.

An early SVPT demonstrated on a two-phase geothermal well is shown in figure 2. This unit generated 700 kW from the high pressure brine and steam let down.

Figure 2 Geothermal Separating Turbine

Energent is currently applying this technology to applications that benefit from simultaneous pressure recovery and compact separation. These include geothermal power production, floating LNG production and other processes using two-phase Joule-Thomson valves.

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