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## Phase equilibrium of the melt-vapor in the tellurium-sulfur system

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**Statement of the Problem:** In the distillation technologies of chalcogen purification, there is a problem of isolating one of the elements in pure form in the presence of the other two. Earlier, our studies of binary selenium-sulfur and tellurium-selenium systems revealed that the cause of the difficulties is the narrow field of coexistence of the melt and vapor in the first case and the presence of an azeotropic mixture in the second. A similar study of the tellurium-sulfur system in the sources of information was not found. The aim of the study was to construct the boundaries of the phase transition of the melt-vapor of the tellurium-sulfur system.

**Methodology:** The boundaries of the field of coexistence of the melt and vapor are determined on the basis of the partial pressure of sulfur and tellurium vapor determined by the boiling point method and integration of the Gibbs-Duhem equation. The temperature of boiling of a melt of a certain composition was assumed to be the temperature at which the sum of the partial pressures of sulfur and tellurium is equal to atmospheric pressure. The composition of the vapor phase is defined as the ratio of the partial pressure of the component to the total pressure at the boiling point.

**Result:** As a result of the investigation, the fields of coexistence of the melt and vapor at atmospheric pressure and in a vacuum of 2000 and 100 Pa (the last shaded) are plotted on the existing diagram of the tellurium-sulfur state (Fig. 1). The boundaries of the melt-vapor phase transition indicate the possibility of a fairly complete separation of the tellurium-sulfur system into elements by a single distillation. Lowering the pressure to the forevacuum shifts the boiling point and most of the field (M+P) to the two-phase region of coexistence of solid sulfur solutions in tellurium (Te) and the melt. That is, in vacuum, the evaporation of sulfur will be accompanied by crystallization (Te) with its accumulation in the bottom residue with a decrease in the concentration of S in the melt to ~86.7 at % (61.9 mass%) (determined graphically) at a pressure of 2000 Pa and up to ~93.3 at % (77.8 wt%) at 100 Pa. Thus, distillation purification of sulfur from tellurium does not present technological difficulties, the vapor phase is almost completely represented by sulfur, and tellurium will concentrate in the bottom residue.

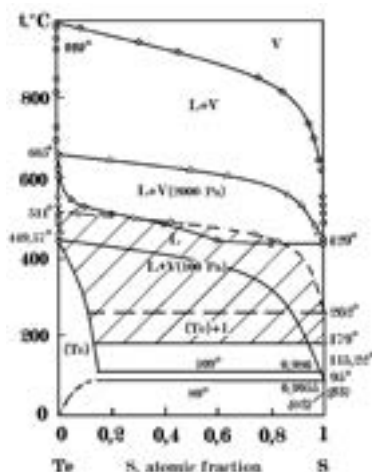


Figure 1: Diagram of the state of the tellurium-sulfur system

### Biography

Valery N Volodin is engaged in the development of distillation technologies for separation of chalcogenide melts and metal refining in vacuum. His field of interests includes thermodynamics and vapor-liquid equilibrium. The partial pressure of the vapor components is used as the basis for determining the boundaries of the liquid-vapor phase transition for high-temperature melts.

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