EXTENDED DESCRIPTION THERMAL PROPERTIES OF CARBON DIOXIDE USING EQUATION OF STATE WITH A SMALL NUMBER OF PARAMETERS

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A new combined thermal equation of state (EoS) with a small number of adjustable parameters is proposed, which describes both the regular and critical areas. This equation approximates experimental p, V, T -data of CO_2 in the intervals of their measurements ($0 < V_c/V < 2, 217K < T < 430K, 0 < p \leq 25MPa$). The array of p, V, T-data consisted of 731 points. The proposed EoS is an explicit function of V, T and is written in the form of:

$$p/p_c = (1 - Y)p_{reg}/p_c + Y p_{scal}/p_c.$$

The EoS includes a new regular part of p_{reg} for approximation of p, V, T -data outside the critical region, a singular scaling part of p_{scal} for the critical region, and a transitional (crossover) function Y. Comparison of the calculating results of pressures using this EoS with experimental and reference table data, even outside the approximation intervals up to 200 MPa, showed that they coincide within the data error. The high accuracy of approximation of CO_2 thermal data by the proposed equation made it possible to calculate the behavior of other properties, using the coefficients of this EoS, including caloric values in the specified regions of system state by the known thermodynamic relations. It was calculated the isochoric heat capacity, enthalpy and adiabatic speed of sound. The comparison of the obtained values with the known experimental data has shown their good coincidence. Thus, the proposed combined EoS makes it possible to develop reference tables on thermodynamic properties of CO_2 in a wide range of states, including the critical area. It is possible to calculate the calorific properties and sound velocity also for other liquids using a new equation of state, including regular and scaling parts with a relatively small number of adjusting parameters (up to 20).