Efficient heat recuperation is of primary importance in resolving the problem of efficient energy usage and consequent reduction of fuel consumption and greenhouse gas emissions. Plate Heat Exchanger (PHE) is one of the modern efficient types of compact heat transfer equipment. To widen the PHE application range by excluding elastomeric gaskets the welded (WPHE) types of PHE were developed. Here is presented the mathematical model for WPHE of special design for high pressures and temperatures are presented. The validation of mathematical model is made by comparison with data of the tests performed for WPHE installed in ammonia synthesis column operating in industry.

The construction of investigated WPHE is developed for work in high pressure shell of ammonia synthesis column at pressure up to 32 MPa and temperature up to 520 °C. It consists of the stack of round corrugated plates with diameter 626 mm, which are welded together to form a number of channels for cold and hot streams exchanging heat. The welded collectors of special design are organizing multi pass movement of both streams with overall counter flow. The movement of two streams in one pass block is cross flow with overall counter flow in a whole WPHE. The mathematical model of considered WPHE is developed, which enables to perform the thermal and hydraulic design for specified process conditions and also rating calculations of WPHE with determined parameters of its construction.

The validity of the proposed Equations and developed mathematical model was confirmed by comparison with the data of tests on WPHE installed in ammonia synthesis column at

PRES17 conference
industrial enterprise of ammonia production. WPHE was operating in existing synthesis column of ammonia unit instead shell-and-tube heat exchanger. The construction of WPHE and the results of the tests are discussed. The use of WPHE instead shell-and-tube unit enable to cut down the volume occupied by heat exchanger in high pressure shell of ammonia synthesis column and allows increase of the volume of catalyst. It leads to 15% rise of ammonia output.