Summery of the new scientific results in thesis

The main aim was to examine the CO_2 laser brazing of aluminium applying KF-AlF_3 flux. The thesis are connected with the process model of laser brazing, the efficiency of heating the aluminium by CO_2 laser using flux, the optimisation of brazing technology, the surface topography of the joints, and the geometrical and strength characteristics of the laser brazed joint.

1. I developed the process model of the laser brazing of aluminium using flux. In this I analysed the parameters influencing the properties of the laser brazed joints, and integrated them in the new model. Apart from the influencing factors known from the literature, I completed the model with further parameters determined during my own research.

2. I determined new factors influencing heating efficiency in the process of flux applied CO_2 laser heating of aluminium. These are:
   - **the quantity of flux**: increasing the volume of flux (6.5 – 20.6 g/m^2) at a given power density (6 000 – 21 000 W/cm^2) increases heating efficiency. The significance of the volume of flux increases with the increase of power density;
   - **the presence of chemically not bond water in the flux**: the presence of chemically not bond water in the flux (80 weight %) increases the heating efficiency of the laser beam, as compared to dried flux;
   - **the operation mode of the laser**: in impulse mode (50 Hz frequency, 33%, 66% filling) as compared to continuous mode the efficiency of heating the base material decreases, but the speed of heating the flux increases;
   - **the presence of Si in the flux**: presence of Si powder in the flux (33 weight %) increases the efficiency of the laser beam heating of aluminium, as compared to heating without added Si.

3. I developed the technology of aluminium brazing with CO_2 laser using flux, and determined the optimal technological parameters needed to achieve a continuous, smooth joint with the minimal melting of the base material.

4. I established that the speed of CO_2 laser brazing is influenced not only by the factors known from the literature, but also by laser spot division and laser spot distortion defined in my study.

5. I established that brazing paste containing Si can be better applied for laser brazing of aluminium by indirect heating than by direct heating, because this way there is no loss of filler material.

6. I established that with the applicable technology of CO_2 laser brazing aesthetical aluminium joints with little surface unevenness, hardly containing any trace of flow and requiring little post-treatment can be developed.

7. I established that by laser brazing due to the heating and little melting of the base material it is a diffusion joint that is produced, thus laser brazing is not an adhesion joint, as it is stated in some of the publications of the literature.

8. I established that the geometry of the cross section of the seam created by CO_2 laser brazing can be categorized neither as a conventionally brazed joint, nor as a

conventionally welded joint. It is to be evaluated as a hybrid joint falling between the joints produced by the two technologies mentioned.

9. I established that by CO_2 laser brazing of aluminium, the strength of the joint is higher in the case of 1 mm thick base materials – due to the smaller softening – than in the case of thicker, butt joined brazed sheets. This higher strength reaches or surpasses the strength of laser welded aluminium joints. So the development of laser brazed joints, which are joints of high strength, is recommended for 1 mm thick base materials.