

Review of the doctoral dissertation:

**“Explosive acceleration of polymer bonded copper powder”**

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The submitted dissertation is focused on the solution of very important problem for optimizing and next development of the application of Razor charge to demolition works. The meaning of this effort is briefly but well described in the introduction. The general aims of the submitted thesis is focused on the study of shock response of the liner made from polymer bonded copper powder together with the detonation properties of the PISEM explosive.

The introduction chapter is followed by the literature review – see Chapter 1. This chapter is based on data from many literature sources. There is all basic information on the problems which should be solved. The main attention is focused on the description of the shock response of inert materials. The selection of the literature gives a clear evidence of the deep author's knowledge of the given scientific area. The significant attention is also focused on the generation of shock. The description of the Hopkinson Bar is given clearly and in reasonable complexity. The statement that the Hopkinson bar is used to create shocks is questionable. This method enables to achieve high strain rates loading of materials. Very important information are presented in the part 1.2. on shock behavior of some heterogeneous materials which is properly divided in two parts : Porous materials and polymer bounded crystalline powders.

Chapter 2 deals with some review on the detonation parameters and effects. The literature review work involves the most important data on the problem to be solved. The data were obtained using of relevant scientific literature sources. The level of presentation gives the evidence on the author's knowledge of the problems. I would only like to comment that the Guerney equation (2.1) is now subjected to some correlations.

The chapter 4 deals with the description of the experimental arrangements and simulations. The author uses many different techniques. Each of them is useful for the investigation planned in the thesis. The description is made on very good level. It is evident that the author has excellent knowledge on this problems including the numerical simulation. For the more complete description this simulation some references on the Johnson Cook constitutive equation, Steinberg material etc. should be given. In connection with the tested material which may exhibits some viscoelastic behaviour I would like to ask why some DMA technique was not used?

The proper results of the submitted thesis are presented in part III together with their discussion. Generally the results represent a nice piece of work. Very important are values of longitudinal wave velocities- see 5.1. Results of part 5.2 obtained using of the Hopkinson Split Bar Technique are useful but for the description of the material behaviour. This behaviour is based on the dependence of the flow stress on the strain rate. Generally, this dependence in the very broad extent of strain rates is needed. It must be also based on the use of some other experimental techniques like tensile testing machines etc. The problem of the evaluation of the constitutive equation of the given material represents a topic for next thesis. The knowledge of this equation enables the numerical simulation of the studied problem. Very useful information are involved in 5.3. The knowledge of  $U(u)$  enables to design e.g. Mie Gruneissen equation of state which can be used in the numerical simulation. Very interested are also results of the comparison of the poly Cu powder with some relevant materials. The connection between results of the planar impact experiments' with results of the Hopkinson bar is very suppressing. As I know this knowledge has not been published up to now. Excellent results represents also chapter 5.4 on the explosively accelerated inert. The comparison with gas gun results is also very important and involves many topics on the next consideration. New insight on the behaviour of the tested material was obtained using the in-contact explosive loading technique. The visualisation of the explosive loading brings also some valuable information on the behaviour of explosive loaded material. Results of this part represent very valuable contribution both for the basic research as well as for the practical applications.

Chapter 6 brings detail information on the detonation properties of PISEM explosives. Very valuable is namely the JWL equation which can be used in the numerical simulation of the explosive events. In the Table 6.1 it would be desirable to present units of the coefficients. Very interested is also chapter 7 on the Razor charges. The data presented in this chapter represent very valuable information on practical use of these charges.

The summary and conclusion are formulated very preciously. They confirm that the main goals of the submitted thesis have been achieved. I would like to ask on the author's meaning on the possibility of the numerical simulation of the Razor charges ability to cut metal? Which results should be add to the results of the given thesis in order to be able to do it?

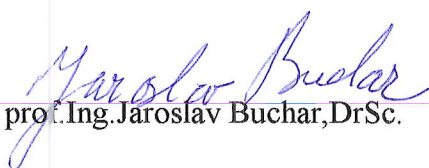
Results of the given thesis represent very valuable contribution both for the basic research as well as for the practical applications. In the area of basic research the main contribution represent results of the gas gun loading and results of Hopkinson bar, namely the connection of these results. The same is valid for the results of explosive loading. From practical point of view the very valuable are results on the detonation properties of PISEM explosives and results of

chapter 7 on the Razor charges. This is only a brief survey describing the general features. The very high level of the submitted thesis is also documented by the published papers in the well-known international journals as well as contributions to many significant international conferences. One can expect that their number will rapidly increase in the future.

**Concluding remarks.** The submitted thesis exhibit all features required for the PhD thesis. The professional level of the thesis clearly shows that the author is able to solve significant scientific problems. I can only recommend to accept this thesis for a defence. After the successful defence I suggest to grant to MSc Aline Cardoso Anastacia the academic degree

**D o c t o r of Philosophy (PhD)**

Lonnie and Populous, September 11, 2018.

  
prof. Ing. Jaroslav Buchar, DrSc.