

Preface

“The principal part of a chisel is the cutting edge. If there is a single principle on which our business rests—it is that.”, Henry Ford wrote in his memoirs “My life and work”. A contemporary of Henry Ford was Frederick Winslow Taylor. We know him as the first engineer, who worked scientifically in the field of cutting technology. His work “On the art of cutting metals”, published in 1907 was the first scientific contribution in the field of manufacturing which was able to describe parts of the cutting process qualitatively as well as quantitatively.

The significance of cutting and abrasive processes has grown substantially during the last century with the development of the automotive, aircraft and machine building industry. Therefore, the theory of these processes and knowledge about their application in industrial practice are a prerequisite for the studies of manufacturing science and an important part of the curriculum of the master study in German mechanical engineering.

The basis of this book is our lecture “Basics of cutting and abrasive processes” (4 semester hours/3 credit hours) at the Leibniz University Hannover, which we offer to the diploma and master students specializing in manufacturing science. We present the knowledge of modern manufacturing in these technologies. Comprehensive research in the laboratory of Production Engineering and Machine Tools of our institute introduces the newest results in the relevant fields.

The introductory chapter explains the significance of cutting and abrasive processes to manufacturing science using examples of industrial practice and gives criteria to evaluate cutting and abrasive processes with respect to economic and ecological issues. General material removal principles are presented in the next chapter. Large strains and strain rates and the moving of material with its instantaneously generated new surface over the tool faces under high load, are the specific characteristics of cutting in general. However, there is a broad variety of processes requiring a systematic taxonomy.

The following chapters discuss the four basic criteria, i.e. chip formation, forces and power, wear and surface generation. We see an important impetus on our work in a scientific and analytical approach to cutting and we have tried to describe the phenomena and their dependencies on input variables based on physical models and perceptions rather than presenting mere empirical equations. A particular chapter on modelling and simulation was written due to the fact that meanwhile,

there is a large variety of highly productive options to determine process and effective variables, not only in a momentary recording but also on the basis of kinematic or motion studies, which are adapted to actual machining processes, i. e. illustrate the ongoing process. It is the concern of this chapter to enable the reader to find his way around the various approaches and their limits. Dr.-Ing. Böß with his mathematical competence, took over the generation of this section to a large extent.

The progress of cutting and abrasive processes is strongly based on the development of cutting materials. Therefore, the different materials and their specific application domains described are followed consequently by new technologies, e.g. hard machining, high speed and high performance cutting.

New findings concerning the influence of the micro-geometry of the cutting wedge on the wear behavior of a tool, on the force and performance requirements in cutting and not least, on the surface influence have been included. The chapter “Surface and surface zone properties” contains the latest status of measurement possibilities, based on the work of Dr. rer. nat. habil. Breidenstein.

We owe some valuable information about new processes for the dressing of grinding wheels, which have just recently been put into practice, by Prof. Dr.-Ing. T. Lierse and the company Kaiser GmbH, Celle. Numerous co-workers of the institute have helped to accomplish this edition. Therefore, we would especially like to thank Dr.-Ing. V. Böß, Dr. rer. nat. habil. B. Breidenstein, Dipl.-Ing. J. Henjes, Dipl.-Math. A. Schindler and Dipl.-Ing. V. Sellmeier for their committed and competent co-operation. We would also sincerely like to thank Birte Fischer and Julia Körber, who carried out the translation.

Your suggestions and corrections will be appreciated.

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