Sound Pattern of the Panel Saws Family

Marcos D. Fernández, José A. Ballesteros, Iván Suárez, Samuel Quintana, Isabel González and Laura Rodríguez

Escuela Universitaria Politécnica de Cuenca, Universidad de Castilla-La Mancha, Campus Universitario, 16071 Cuenca, Spain

"A type of machines" can be understood as a set of machines that have some part in common, and are generally used for the same function. Therefore, it seems logical to think that they should usually share the same working philosophy, which often includes a similar noise emission. This reasoning will be proved by the comparison of the different factors that characterize a machine, that is, the measurement of sound power level and sound quality. All of this should be done for a number of machines to guarantee enough heterogeneity in the test samples so as to probe the existence of a trend in the acoustical characteristics of the machines of the same family. This will lead to the existence of a sound pattern. It has been possible, for the panel saws family, to determine that emission pattern. The knowledge of this sound pattern offers a wide set of possibilities that permit emission reductions and protection of workers.

1. INTRODUCTION

The acoustical characterization of a machine is understood as the determination of its acoustic power, together with all the needed parameters for its measurement, and the sound exposure of the worker to the noise emitted by the machine. It also includes the determination of the sound quality of the machine, including objective psychoacoustic parameters and subjective surveys. With all these data an acoustical report, giving its acoustical characterization, can be completed.

Furthermore, once a machine is characterized, studies can be done by crossing acoustical and psychoacoustic data to search for possible relations among them; however, maybe the most interesting aspect could be the determination of the sound pattern of families of machines, aimed at finding out common descriptors and relations to all the studied machines; this is based and inspired in the norm ISO 11689, which explains how to collect and compare noise-emission data for machinery and equipments.[1]

1.1. Machine under Test

Woodworking machines can be classified into two major groups: those using cutters and those using saw blades. This paper deals with a subset of the second type: panel saws, which comprise a fixed surface where a circular saw blade is inserted and a mobile mechanism pushes and pulls the wood to be cut.

Circular saws are responsible for the great majority of employee overexposures in the woodworking industry. The noise emitted by this element can be grouped into three different source categories: aerodynamically produced noise, blade vibration produced noise, and workpiece vibration produced noise.[2,3]

1.2. Necessary Measurements

The sound power level is the first measurement to be taken. The steps established in the norms ISO 9614-2 and ISO 3744, of sound power level measurement from intensity scans and from the sound pressure levels measured in the free field, respectively, are followed.[4,5]

If the measurement is, made inside a room, in keeping with ISO 3744, the reverberation time must also be measured, using the provisions in norm ISO 3382.[6] To make this measurement, it is necessary to know the K_2 parameter for the room correction.

The next step to characterize a machine acoustically is to determine the most important objective psychoacoustic parameters. These are loudness, roughness, sharpness and fluctuation strength, as defined by Zwicker and SIL (Speech Interference Level).[7,8]

The measurements were taken at the work station, unless a specific position was indicated by the norms used, as it is stated in norms ISO 11204 and ISO 11205.[9,10]

1.3. Subjective Evaluation

Product sound quality is a descriptor of the adequacy of the sound associated with a particular product. It comes from human perceptions and judgments. Subjective evaluation of the sound quality is based on exposing a group of listeners to the sound of the product (life or recorded), and then asking them to make individual subjective responses according to the scales chosen, which are averaged so that they can be useful for analyzing and comparing the other measurements objectively taken.[2]

In this case, to evaluate the sound quality subjectively, a set of two surveys of differential semantics have been used for every evaluated machine under optimum conditions.[11,12] A minimum of 16 capable listeners are required.

The first test verifies that the listeners are capable of answering the calibrated acoustical stimuli coherently.[13] Additionally, this first test accomplishes the function of training, given that it is made from the evaluation of four characteristics of six sound probes.

Once the listeners pass the first test, the real evaluation of the subjective sound quality begins. The listener must choose the type of machines and how many of them he/she will evaluate.