CARBON CONTENT AND TEMPERATURE CONTROL IN THE PRODUCTION OF HIGH QUALITY MEAT CUTLERY

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The function of carbon is to make the steel harder and more wear-resisting. The lowest carbon likely to be found in professional cutlery steels would be about .50% to .60%. As more carbon is added, the steel's capacity to harden is increased until about .80% carbon is reached, whereupon it will become file hard when quenched. Adding more carbon than this does not increase the measurable hardness, but it does increase the wear resistance. The highest carbon normally found in cutlery knife blades is 1.10%. This becomes very hard, has good wear resistance and yet the carbon is not high enough to make it brittle.

In a discussion of heat treating, the operations can be covered under the headings of "Temperature" and "Time." If the blades are heated to the proper temperature, at the proper rate, soaked for the proper time, and cooled at the proper speed, good blades will result.

For each steel analysis there is a definite temperature range within which the steel should be heated. This hardening temperature must be controlled for many reasons. If the temperature is too low, the steel will fail to harden properly and toughness will be impaired. Over-heating is also objectionable. It increases scale and decaburization and when carried to excess causes grain growth, brittleness and eventually cracking.

Time involves the rate at which the steel is heated up to its maximum temperature, the degree of soaking at temperature and the speed of cooling. The rate at which the blades are heated for hardening is of some importance. The fastest rates are secured in a lead pot and this is the method we use in hardening our blades. Too rapid heating is objectionable because it causes the blades to heat non-uniformly and also causes grain growth when rapid heating is continued through the critical temperature.

Temperature control at hardening is secured by use of instruments known as pyrometers. These instruments consist of a thermo-couple which projects in the furnace and is connected to a dial or chart which indicates the temperature. The controllers maintain the temperature of the lead pot within a range of 5° by controlling the fire which heats up the lead. These instruments can be compared in a sense to a delicate thermostat which controls the heat in a house. The operator sets up the cycle of hardening by loading the tongs which hold the blades, soaking them for the required time in the molten lead and then quenching them in a tank of oil. The hardening temperature for knives for the meat industry is about 1480° to 1500°. The blades are kept in the lead for a period of 2 to 2½ minutes.

Further temperature control is necessary to complete the heat treating of the blades in an operation called tempering. The purpose of this operation is to relieve the strain set up in hardening and to increase the toughness so that the blade will not break in the bending and twisting to which it

may be subjected in use. Tempering is accomplished by heating the blades to a temperature of 560° for a period of two hours in an electric furnace. These furnaces can be set to automatically bring the blades to the proper temperature, heat them at that point for two hours, and then shut off the heat and allow the blades to cool slowly.

A method of testing to ascertain the effectiveness of heat treating controls is a hardness test. The most widely used test is a Rockwell Hardness Tester. This instrument measures on a calibrated dial the relative hardness of the specimen by measuring the depth of impression of a diamond point under a certain fixed load. The softer the material, the deeper will be the penetration. An arbitrary scale known as the Rockwell C Hardness scale is used. After the hardening operation, the reading should be 65 to 67 on this scale. At this reading, the blade is fully hardened. The tempering operation reduces this hardness as it increases the toughness. There are differences of opinion in our industry as to the best hardness to which the blades should be tempered. By changing the tempering temperature, any hardness below 65C can be obtained. Our experience has led us to establish a Rockwell hardness of 54-56C scale as the best for most meat packing and meat processing blades. On some knives for the rubber industry, we use a Rockwell of 60-61C with a special alloy steel but practically all knives used for cutting meat are tempered to 54-56C scale.

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(The meeting recessed at 12:30 o'clock.)

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