Table 4.2 Different grades of sugar according to their particle size.

Grade	Particle size
Coarse sugar	1.0–2.5 mm grain size (0.04–0.1 in)
Medium fine sugar	0.6–1.0 mm grain size (0.02–0.04 in)
Fine sugar	0.1–0.6 mm grain size (0.004–0.02 in)
Icing sugar	0.005–0.1 mm grain size (0.2×10^{-3} to 0.004 in)

50% solution with a pH value of 7.0 at a wavelength of 420 nm. The coefficient of extinction established in this way and multiplied by 1000 represents one ICUMSA unit (International Commission for Uniform Methods of Sugar Analysis). The ICUMSA colour type (Braunschweig system) is determined by visual comparison with calibrated colour standards, which may be obtained from the Nordzucker AG ITB (formerly The Institute for Technology of Carbohydrates – Sugar Institute, Braunschweig, Germany). The ash content is determined in a 28% solution by conductivity measurements as the so-called "conductivity ash". According to the method employed, 1 μS/cm in a 28% solution represents 5.76×10^{-4}% ash. The values thus determined are converted into points and the points added up to give a total score for the sugar. As a rule, category 2 sugar is used for the manufacture of chocolate. Category 3 sugar is slightly cheaper and of a quality, which in most cases suffices for the manufacture of chocolate. It is, however, not available in many countries.

White crystallised sugar should be free flowing and have crystals of uniform particle size. There are no legal stipulations regarding grains or particle size. Nevertheless, the following grading may be carried out by sieving and is more or less generally accepted (Table 4.2; Diefenthäler, 1974).

The manufacture of chocolate masses is predominantly based on the use of medium fine sugar. Some chocolate manufacturers, however, insist on certain specifications concerning the particle spectrum. For example, some factories which refine masses in a two-step procedure (see Chapter 9) specify a spectrum of 0.5–1.25 mm (0.02–0.05 in) with an amount of fine grain [<0.2 mm (<0.008 in)] up to, but not exceeding, 2%.

4.4 The storage of sugar

In most cases, sugar is delivered to the chocolate industry by means of road tankers and not, as in the past, in bags or sacks. The sugar is pneumatically discharged from the vehicles into silos, where it is stored until further processing. Four factors are important in the silo storage of crystal sugar (Kelm, 1983): grain structure, moisture content, apparent of bulk density and angle of repose.

The grain structure of crystallised sugar is determined by the grain size, shape of the grains and the grain size distribution. The sugar industry supplies sugar that has been sifted to well-defined particle sizes, shows a good fluidity and is thus suitable for silo storage. In European countries, such as the UK, France and Germany, the chocolate industry is mainly supplied with sugar within the size range 0.5–1.5 mm (0.02–0.06 in). The amount of dust [grain size ≤0.1 mm (≤0.004 in)] is generally below 1% at the time of delivery in a road tanker.

The sugar should, if possible, consist of regular-shaped individual crystals, since irregular conglomerates have a detrimental effect on the bulk sugar's rheological properties. Problems may also arise from sugar dust. This may be formed during pneumatic handling because of friction against the inner surfaces of pipelines, especially at the site of manifolds. The amount of fine grain [<0.2 mm (<0.008 in)] and dust [<0.1 mm (<0.004 in)] present in the sugar correlates with its flowability and both should therefore be kept as low as possible. With 10% dust, storage and discharge problems are likely to occur. At dust levels of 15% or more, proper silo storage becomes impractical (Gaupp, 1972). Thus, special attention should be paid to ensuring an optimum layout of handling equipment, such as pipeline design, manifold radius and feeding rate, in order to keep the mechanical breakage of the sugar as low as possible.

A minimum feed rate of about 11 m/s (36 ft/s) is required for sugar transport. However, the handling conditions should be designed in such a way that the feeding rate does not exceed a speed of about 22 m/s (72 ft/s; Tills, 1970).

The moisture content of sugar is extremely low. Its actual level, however, has a decisive influence on its storability. After drying and cooling, freshly produced sugar has a total water content of about 0.1%, which is further reduced to 0.03–0.06% by conditioning in the silo of the sugar factory.

The surface moisture of the sugar changes as a function of the relative humidity of the ambient air. Figure 4.1 shows this dependency by means of the sorption isotherms of sugars of differing purities at 20 °C (68 °F; Kelm, 1983). Each sorption isotherm is a function of the sugar's purity and also of its ash content, traces of invert sugar and crystal size. As may be seen, the curve runs almost parallel to the abscissa at 20–60% air relative humidity. This implies that there is practically no water uptake even when the relative humidity of the air is increasing. Only when the relative humidity of the air exceeds 65% water is increasingly absorbed on the crystal surface. This implies that proper storage requires a temperature of 20 °C (68 °F) and a relative humidity ranging from 20 to 60%.

A relative humidity of more than 65% exponentially increases the water content in the sugar. Wet sugar must be avoided at all costs as it can become chemically and microbiologically contaminated. In addition, if wet sugar is stored at a relative humidity below its equilibrium relative humidity (ERH) the sugar will cake during drying and become lumpy.

Purer sugars (category 1 with lower ash content) and sugars with a coarser particle structure possess superior storage properties. On delivery, the surface water content of any sugar should not exceed 0.03% (Neumann, 1974).