Determenation of Silica in feed

- The cell walls of grasses also contains silica.

Silica : Silicon dioxide (SiO2), the main component of sand or glass.

- **Silicon** (Si) is a non-metallic element and is one of the most abundant elements in the earth's crust. Earlier studies in laboratory animals suggested that silicon might be an essential nutrient but those studies have not been validated. Some of these studies indicated that silicon is associated with connective tissue and bone metabolism, because animals fed diets low in Si had less bone collagen and hexamine content than animals fed higher amounts; however, bone mineral content and animal growth were not affected. No dietary Si requirement has been set for any of the farm animal species.

- Most silicon ingested directly is excreted without being absorbed, but that in leafy plants is more readily absorbed and high concentrations of silica in the urine can cause the formation of siliceous calculi and urolithiasis. This condition is most likely if water intake is low and less urine is passed.

Classification of forage fractions using the detergent methods of Van Soest (MC Donald et al 2010)

Table 1.2 Classification of forage fractions using the detergent methods of Van Soest

Fraction	Components
Cell contents (soluble in neutral detergent)	Lipids
	Sugars, organic acids and water-soluble matter
	Pectin, starch
	Non-protein nitrogen
	Soluble protein
Cell wall constituents (fibre insoluble in neutral detergent)	
Soluble in acid detergent	Hemicelluloses
	Fibre-bound protein
Acid-detergent fibre	Cellulose
	Lignin
	Lignified nitrogen
	Silica

After Van Soest P J 1967 *Journal of Animal Science* 26: 119.

Silicon toxicity (silicosis) has long been known as an illness of miners caused by the inhalation of silical particles into the lungs. Under some conditions, part of the silicon present in urine is deposited in the kidney, bladder or urethra to form calculi or uroliths. Silica urolithiasis occurs in grazing wethers in Western Australia and in grazing steers in western Canada and northwestern parts of the USA. Excessive silica in feeds, for example in rice straw, is known to depress organic matter digestibility. In mature forage, silicon is in the form of solid particles, which are harder than dental tissue and lead to teeth wear in sheep.

Dynamics of digestion in the ruminant

Food enters the rumen in the form of particles of various shapes and sizes, which are at first suspended in the liquid phase. The soluble constituents of these particles (such as sugars) are quickly dissolved and can thus be rapidly degraded by the rumen microbes. The insoluble constituents are colonised by microbes and

slowly broken down. In addition to these two fractions, a third component will consist of cell walls so heavily encrusted with lignin or silica as to be undegradable in the rumen. The dynamics of the rumen must be such that potentially degradable material is retained long enough to be digested, and that the products of digestion (together with undegradable material) are passed out of the stomach, either by transit to the lower gut or by absorption through the rumen wall. The partition required is aided by some of the physical characteristics of the rumen contents. The liquid phase of rumen contents may be envisaged as a tank of fixed volume, so that liquid or food entering it causes a corresponding volume to flow out through the reticulo-omasal orifice. This liquid carries with it some of the soluble constituents of the food, some bacteria, the volatile fatty acids that have not been absorbed through the rumen wall, and also some fine particles of food.

Food particles that are large, irregular in shape (e.g. long and thin plant fragments) and of low specific gravity tend to move to the top of the rumen (in some cases, floating on the liquid phase) and are retained; this is desirable, as large particles will not have been subjected to mechanical and microbial breakdown. When these particles are reduced to smaller and denser fragments, they descend in the rumen liquor and can be washed out, as described above.

A critical size for particles passing out of the rumen of sheep has been estimated by sieving digesta as about 1 mm (i.e. particles held on a sieve with holes of 1 mm are regarded as being too large to leave the rumen). For cattle, the critical size is considered likely to be 3–4 mm. However, the passage of particles from the rumen is too complicated to be explained solely in terms of sieve dimensions. The reticulo-omasal orifice is not a sieve and is large enough to allow the passage of particles much herbivores greater in diameter than 1 mm.What seems to happen is that the mass of food particles itself acts as a sieve, by what is termed a filter-bed effect, with large particles trapping smaller ones.

The rate of passage of liquids through the rumen is faster with roughage diets than with those containing concentrates such as cereal grains, because greater rumination of roughages adds more saliva to the digesta. Adding salts to the diet increases water intake and thus increases fluid flow through the rumen. An increased rate of passage of liquid may ‘wash out’ bacteria, thus reducing cellulolysis and increasing the proportion of propionate in the mixture of volatile fatty acids produced. More generally, anything that increases the rate of passage of digesta from the rumen is liable to reduce the extent of digestion in that organ; for the fibre constituents of foods, this is likely to be disadvantageous, but it may be an advantage with constituents such as protein and starch, which can be more efficiently digested in the lower gut. As food intake rises, the ruminant responds by increasing the quantity held in the rumen (rumen ‘fill’) and/or the rate of passage, but eventually limits are reached that impose a restriction on intake. The feeding of ruminants for greater productivity often depends on the raising of these limits, for example by replacing slowly digested forages with rapidly digested concentrates, or by grinding forages to produce smaller, faster-moving particles.