SALT

Part 1 – General

Occurrence

Salt or Sodium Chloride occurs naturally as rock salt in beds varying from a few inches to many feet in thickness. In addition salt is found in sea water (about 2.5%) and it is an essential constituent of animal body fluids (blood plasma contains about 0.8% sodium chloride).

Pure sodium chloride forms as colourless transparent crystals, but native rock salt is often red or yellowish and frequently opaque due to the presence of impurities. The proportion of sodium chloride in rock salt is generally greater than 90%; Calcium Sulphate and Magnesium Chloride are the chief soluble impurities.

Rock salt deposits are widely distributed throughout the world. In the United Kingdom the deposits occur in the New Red Sandstone formations which were laid down after the coal measures. Wide New Red Sandstone outcrops surround the Midland, Staffordshire and Lancashire coalfields in the west, and the Notts-Yorks-Derbyshire and Durham coalfields in the east. Other outcrops extend southwards through Gloucestershire and Somerset.

The Red Sandstone is subdivided in a lower Permian series and an upper Triassic series. A greater part of the English salt deposits occur in the Keuper Marl sub-division of the Triassic series, although the Durham salt field has been assigned to the later Permian series.

The rock salt beds were formed by the solar evaporation of enclosed, or intermittently enclosed, areas of sea and give a positive indication of the tropical climate of England in Permo-Triassic times. The salt formed was preserved from re-dissolving in water by the subsequent deposition of impermeable Keuper Marl and rock salt exists today in those areas where the marl layer was sufficiently thick to prevent percolation of water to the rock salt bed.

In the course of time, natural drainage, probably along faults, brought fresh water into contact with the rock salt bed, and underground brine streams formed.

It was this natural brine, appearing as springs at the surface, which was worked from earliest times, long before the existence of underlying rock salt was known.

Because of its ready solubility in water no outcrops of rock salt are found in this country and its presence is only proved by boring. A clear indication of the presence of salt is given by the occurrence of brine springs and ground subsidence resulting from the dissolution of rock salt beds below.

Salt has frequently been discovered in borings during the search for coal and other minerals, and even in boreholes sunk for water.

Salt is produced in England mainly from the Cheshire, Preesall (Fleetwood), South Durham, Staffordshire and Worcester deposits, but the actual salt fields are known to be far more extensive than this list implies. The Cheshire salt field, which yields over 80% of the UK production, extends southwards into Shropshire and the total Cheshire rock-salt reserve has been estimated at 400,000 million tons, or enough to supply the United Kingdom's total needs for over 100,000 years.

There are no known salt deposits in Scotland, but deposits also occur at Carrickfergus in Northern Ireland, in the Isle of Man, and in the Barrow-in-Furness region of North Lancashire.

History

Salt production is of great antiquity and might be called the oldest inorganic chemical industry. It was probably obtained in earliest times by the solar evaporation of sea water or natural brine although the natives of primeval Cheshire are supposed to have obtained salt crystals by pouring the brine over hot wood faggots.

The Romans first introduced the open-pan method of brine evaporation using small lead pans thought to have been an earlier Chinese invention. This method of production persisted almost unchanged throughout the Middle Ages until the 16th century, when larger iron pans were first made.

Before the development of coal mining in Lancashire and Staffordshire, Cheshire salt was produced over wood fires and the forests of the area became gradually depleted.

In early times Cheshire salt was obtained from brine springs of wells around which the three salt towns or 'wiches' of Northwich, Middlewich and Nantwich grew. In 1675 these three towns produced 27,000 tons, while the country's total production was then only 30,000 tons.

Rock salt was first discovered in 1670 during a search for coal at Marbury, near Northwich, and active rock-salt mining at both Northwich and Winsford followed this discovery.

An important export trade in salt was stimulated when the River Weaver was made navigable in 1732. The Weaver Navigation was never extended above Winsford to Nantwich and salt production at the latter town declined during the 18th and 19th centuries. By 1860 it had ceased altogether.

The mining of rock salt declined during the latter half of the 19th century being gradually replaced by the more economic method of brine pumping. The pumping of

brine from the flooded abandoned workings at Northwich was responsible for the catastrophic subsidence which took place in that area at the turn of the century.

Present day brine extraction takes three forms:-

(1) 'Wild' or Natural Brine Pumping – Straight withdrawal of the natural brine.

(2) Circulation of water down a borehole to dissolve the salt and pumping the resulting brine.

(3) Controlled Pumping – As (2), but the cavity formed at the base of the borehole is confined and pressurised. Pumping only continues as long as the pressure is maintained.

All three methods can result in ground subsidence. In the case of 'Wild' Brine pumping the amount of brine extracted is small compared with the total brine present. Any subsidence which occurs is thus only slightly accelerated by the pumping operations and would have eventually taken place in any case. This natural subsidence occurs slowly and causes the gradual sinking of large areas of countryside lying above the brine stream.

Recent reports suggest that this continued brine subsidence under large areas of Mid Cheshire is less influenced by wild brine pumping than it is by the abstraction of vast volumes of water from the boreholes in South Lancashire. Many of these boreholes have become saline and this could be due to a northward flow of underground brine from under Mid Cheshire encouraged by an excessive pumping of water.

The controlled pumping method, if properly carried out, confines the danger of subsidence to the immediate vicinity of the borehole. Huge underground cavities are formed by this method but these are at great depth and future collapse is considered unlikely.

Production of Salt

Salt Production in the United Kingdom

Over 90% of the United Kingdom's production comes from the Cheshire Salt Field and the table below illustrates the changing fortunes of the Cheshire Salt towns during the last three centuries. It clearly shows the rise and fall of salt production at Winsford which followed the trends in rock salt mining. During this same period Middlewich remained solely dependent on natural brine and increased at a rate unrelated to the increase for the Cheshire salt industry as a whole.

Table I

White Salt – Annual Production (tons)

	1675	*1785*	*1878*	*1951*
Middlewich	5,600	9,500	14,000	150,000
Northwich	16,000	100,000	880,000	2,528,000
Nantwich	5,000	3,000	NIL	NIL
Winsford	250	3,000	1,036,000	250,000
Sandbach	100	100	78,000	150,000
Lawton	NIL	100	100,000	NIL

During recent years, ICI Limited have extended and modernised the only remaining rock salt mine at Meadow Bank, Winsford. Rock salt production from the mine is over 1 million tons per year. This is crushed and widely distributed to highway authorities for ice and snow clearance on roads.

The table below shows the gradual increase in salt production by the United Kingdom during the last century. The totals given represent total salt extracted from the underground deposits. In the second part of the table the total salt output is compared with the actual quantity of white salt produced by evaporation of brine.

The difference represents the considerable proportion which is used direct as brine for chemical production.

Table A

United Kingdom Production of Salt

Year	*Total Output – Millions of Tons*
1860	1.41
1884	2.30
1910	2.00
1925	1.92
1930	2.05
1942	3.60
1947	3.14
1949	3.74
1957	5.58
1958	5.57
1959	5.53
1960	5.83

United Kingdom Salt Production

Comparison of Total Output with Actual White Salt Made

Year	*Total Salt Extracted*	*White Salt Production*
1961	5,669,208	1,228, 800
1962	5,980,746	1,297,200
1963	6,392,409	1.448,400
1964	6,638,000	1,376,400
1965	6,889,000	1,447,200

Sources

(1) Statistical Summary of the Mineral Industry HMSO.

(2. BOT Production Monitor for Salt.

World Production of Salt

The United Kingdom is the fourth largest salt producer being exceeded by USA, China and Russia.

Recent annual outputs are listed below:-

Annual Production in Millions of Tons

	1960	*1961*	*1962*	*1963*	*1964*	*1965*
USA	22.7	22.9	25.7	27.3	28.2	30.8
China	13.7	13.0	11.0	10.0	10.0	13.0
Russia	7.4	6.6	8.4	8.6	9.1	9.3
UK	5.8	5.7	6.0	6.4	6.6	6.9
World Total	83.8	85.0	90.0	93.0	97.0	106.0

Uses of Salt

The major part of the total salt production is used for the manufacture of chemicals and only a very small fraction actually finds its way to the dinner table. The total physiological salt requirement for a population of 50 million people, assuming 5 grams per person per day, is less than 100,000 tons per year. Some of this occurs naturally on the food but since most housewives use far more salt than is really needed the total production for foodstuff use is likely to be more than 100,000 tons and 300,000 tons is probably nearer the mark.

The list below gives typical examples of the many uses for salt.

Chlorine, Caustic Soda, Bleaches, and Chlorates etc.
Soda Ash
Dyestuffs, Organic Intermediates
Soap
Chemicals and Plastics
Textiles
Leather Tanning
Meat Packing
Fish Curing
Dairy Products
Canning, Preserving and Food Processing
Refrigeration
Agriculture
Water treatment
Metallurgy
Highways – (snow clearance)

Typed by Jan Hutson (February 2020)