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Salt market characteristics in Poland on the example of the “Kłodawa” Salt Mine

This article is a brief summary of information on the salt market in Poland. In addition it defines the economic areas in which sodium chloride is used, the sources of salt production and the forms in which it occurs – brine, evaporated salt and rock salt. General information is also given on the evaporated and rock salt producers in Poland. The market shares of individual salt producers, importers and solid salt producers and the countries that are the largest salt producers in the world are also presented. The article generally describes terms the largest rock salt producer in Poland, i.e. Kopalnia Soli “Kłodawa” S.A. The degree of detail of the information provided has been deliberately limited due to its sensitivity and the protection of market data.

Key words: mine, rock salt, sodium chloride, salt mining, salt application, rock salt production, Kłodawa

1. INTRODUCTION

Salt (sodium chloride – NaCl) was and is one of the basic raw materials in the history of civilisation. Salt has been used by man since the dawn of time as an additive in dishes and food products, for the preservation of meat and its preparations.

It was not until two centuries that a change in the direction of use of sodium chloride took place. The use of salt as a raw material in industry has changed the structure of its use and has become a major factor in determining the demand for it.

In countries with a similar climate to Poland, the expansion of the road network and the development of road transport have significantly increased the demand for road salt for slippery control in winter. Salt plays an important role in food processing, agriculture and livestock farming, the chemical industry, thermal energy, pharmaceuticals, metallurgy, road construction.

It is likely that the trend of increasing demand for sodium chloride will continue in the coming decades, so it is necessary to plan in advance how and by whom the supply of this important raw material will be ensured for the Polish economy in the future.

2. SOURCES OF SUPPLY OF SALT ON THE POLISH MARKET

The primary source of salt (NaCl) is bedded and diapir rock salt deposits containing halite. Sodium chloride is also obtained by evaporation of salt water from lakes, sea water and natural and artificial brines, as well as saline mine water.

The salt offered on the market is produced in three forms:

- brine – saturated aqueous salt solution,
- rock salt – a crystalline mineral extracted from a deposit using a traditional mining method,
- evaporated salt – obtained from brine by evaporating water.

Salt producers in Poland with operations based on their own raw materials are:

- Inowrocławskie Kopalnie Soli “Solino” S.A. – obtains brine through leaching of caverns for hydrocarbon storage in the diapir deposits,
- Kopalnia Soli “Kłodawa” S.A. produces rock salt from a diapir deposit using the traditional mining method with the application of a chamber system of mining and mining with explosives,

- KGHM Polska Miedź S.A., “Polkowice-Sieroszowice” mine, where the bedded deposit is mined mechanically using shearers,
- Przedsiębiorstwo Gospodarki Wodnej i Rekultywacji S.A. – Zakład Odsalania “Dębieńsko” Sp. z o.o. – producing evaporated salt on the basis of saline mine waters from coal mines,
- Kopalnia Soli “Wieliczka” S.A. producing evaporated salt from brine obtained from utilisation of underground effluents.

2.1. DOMESTIC PRODUCERS OF EVAPORATED SALT

The largest producer of salt (in the form of brine) in Poland is Inowrocławskie Kopalnie Soli “Solino” S.A., whose production amounts to nearly 2.7 million tonnes per year.

This quantity is determined by converting the amount of salt contained in the brine produced into dry matter. The saturated brine goes entirely to

chemical plants, from which about 20% of the total production is returned to the market in the form of evaporated (solid) salt. The producers of salt evaporated from brine produced by IKS “Solino” S.A. are Ciech S.A. and Anwil S.A. Włocławek.

Zakład Odsalania “Dębieńsko” Sp. z o.o. produces only evaporated salt. Brine for the production of evaporated salt is obtained mainly by desalinating water from coal mines. The desalination process is largely supported by funds from the Ministry of the Environment.

Kopalnia Soli “Wieliczka” S.A. is also a producer of evaporated salt. Brine is obtained from the development of natural water inflows to the deposit. The production of evaporated salt represents a small share of the domestic market. The main sources of revenue are tourism activities and budget subsidies for preserving the mine. In 2021, around 600,000 tonnes of evaporated salt (in solid form) were produced in Poland.

Salt production in Poland including imports is shown in Figure 1.

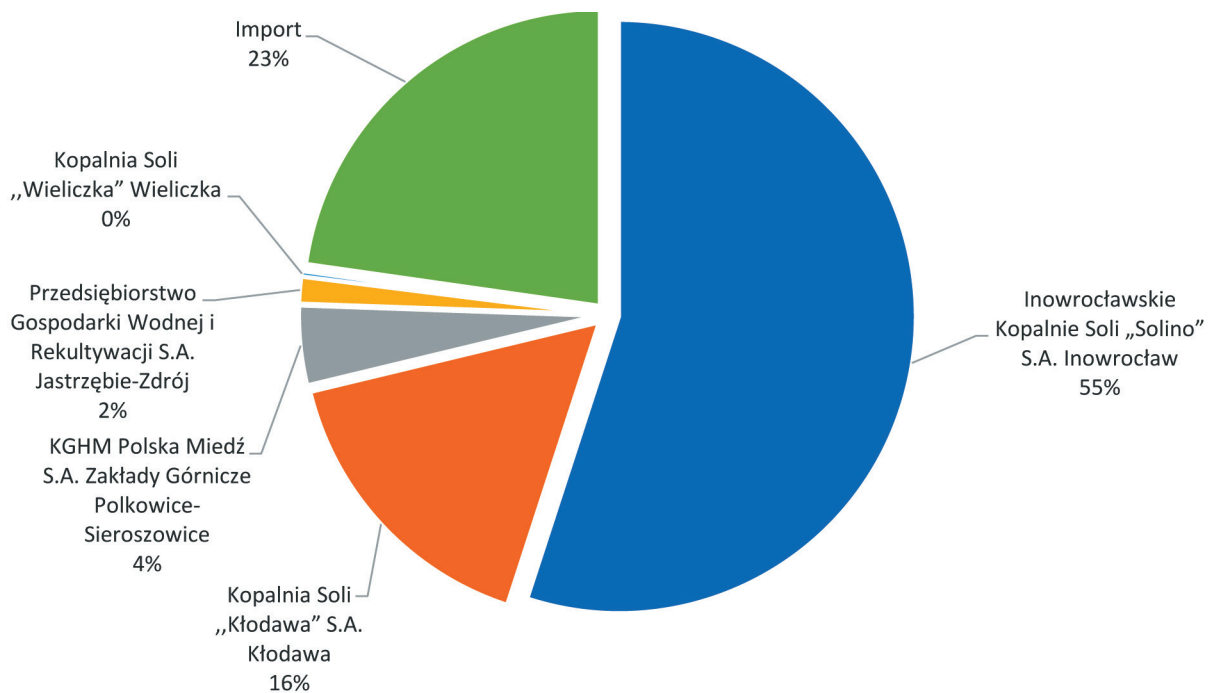


Fig. 1. Salt producers in Poland in 2021 (own data of the Polska Sól Foundation [1])

2.2. DOMESTIC PRODUCERS OF ROCK SALT

In Poland, rock salt is mined in two underground mines. In addition to the “Kłodawa” Salt Mine, rock salt is mined by the “Polkowice-Sieroszowice” mine, which is part of KGHM Polska Miedź S.A. The primary mineral mined there is copper ore, and salt is an associ-

ated mineral. Salt accounts for a small percentage of the overall production and revenue of the mine. Exploitation is carried out using a mining shearer. Rock salt production in Poland in 2021 exceeded 1 million tonnes.

Apart from the offer of domestic salt producers, there are other entities on the Polish market which offer mainly rock salt coming from neighbouring countries: Belarus, Ukraine and Germany.

Rock salt usually has a certain content of parts insoluble in water, therefore it is used mainly in those industries where it is not necessary to dissolve it and there is no need for brine purification. For this reason, in many areas of the economy (apart from road construction), it is mainly evaporated salt that is used – due to its high degree of purity. Demand for evaporated salt is more stable and predictable compared to rock salt.

The largest area of main use of rock salt (in countries with a similar climate as Poland) is in winter maintenance of roads. The development of road infrastructure and traffic volumes in road transport contribute to an increase in the demand for road salt (which also depends on weather conditions during winter). The share of individual domestic solid salt producers in Poland is shown in Figure 2.

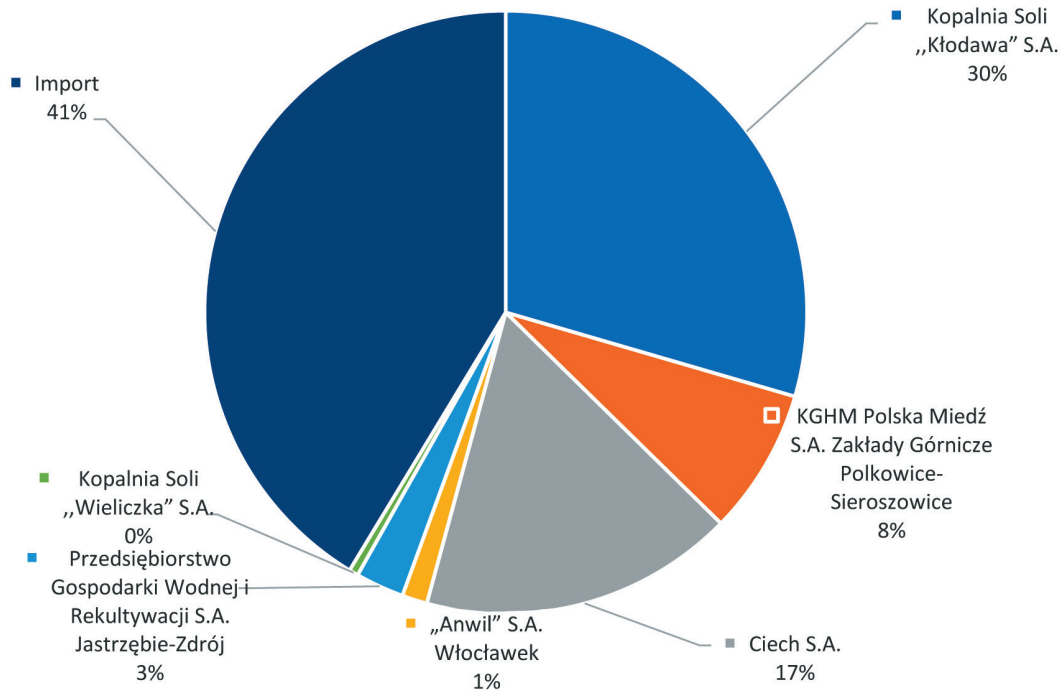


Fig. 2. Solid salt production in Poland in 2021 (own data of the Polska Sól Foundation [1])

2.3. SALT PRODUCTION IN POLAND AGAINST WORLD PRODUCTION

The largest producer of salt in the world is China with a production of around 100 million tonnes. In Europe, the largest producer of salt is Germany with

a production of around 15 million tonnes. Poland produces about 3.9–4.4 million tonnes of sodium chloride, which is about 1.3% of world production. The salt production levels of the world’s largest salt producers are shown in Figure 3.

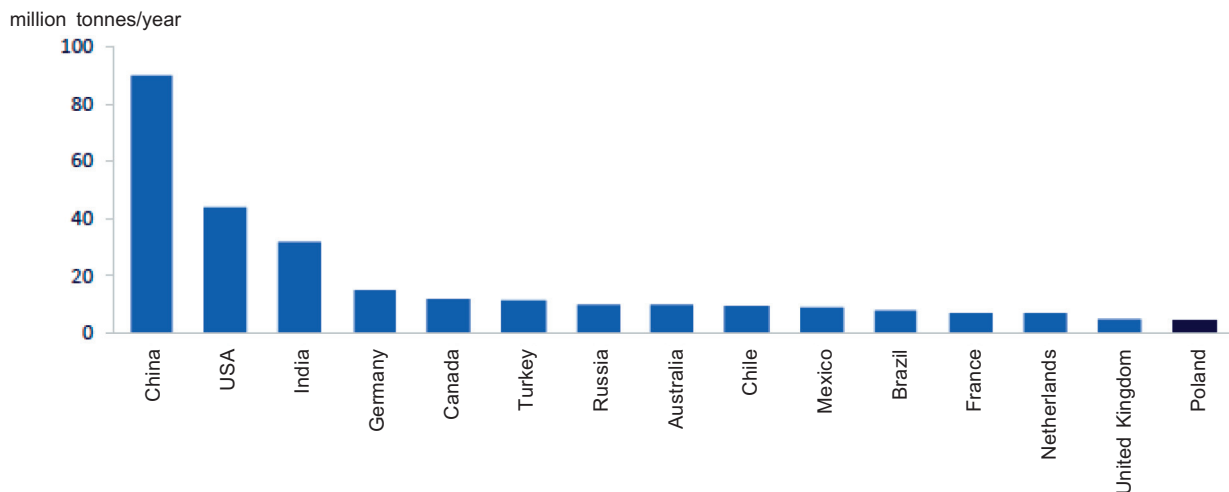


Fig. 3. World’s largest salt producers [2]

3. VOLUME OF SALT IMPORTS TO POLAND

Short-term surges in demand for rock salt in the area of winter road maintenance have the effect of increasing rock salt imports. Salt imports to Poland are directed mainly from Eastern European countries (Ukraine, Belarus) and from Germany. Almost all

imported salt is used for road construction. A certain amount of salt is sold to the electrolysis, feed and food processing industries. The volume of salt imports to Poland in 2021 exceeded 1.1 million tonnes. A comparison of domestic salt production, import and export volumes between 2015 and 2021 is shown in Figure 4.

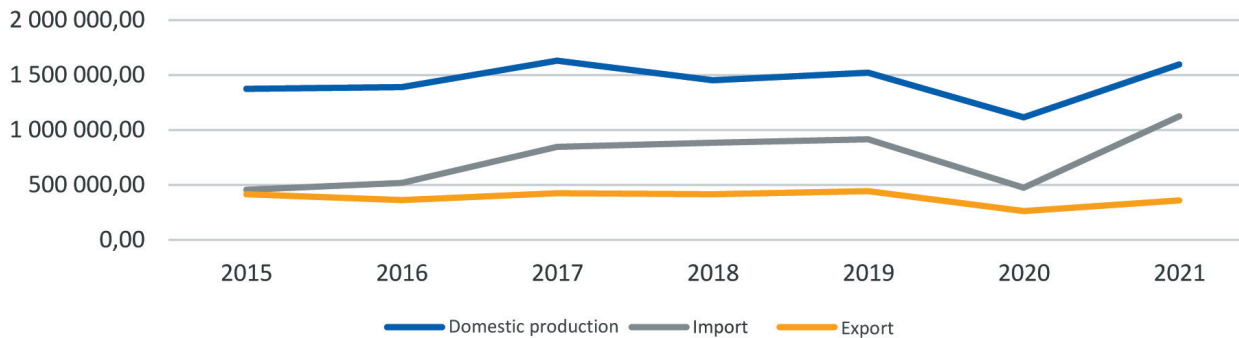


Fig. 4. Comparison of volumes of domestic salt production, imports and exports of salt between 2015 and 2021 (own data of the Polska Sól Foundation [1])

4. CHARACTERISTICS OF THE “KŁODAWA” SALT MINE AS A LEADING PRODUCER OF ROCK SALT IN POLAND

The “Kłodawa” Salt Mine is situated in central Poland, in Wielkopolskie Province, in the district of Koło, in the municipality of Kłodawa. The city is situated in the middle of the road from Poznań to Warsaw on the national road E-92, about twenty kilometres from the motorway A-2 and about 40 kilometres from the motorway A-1.

The history of the mine dates back to the 1930s. At that time, gravimetric surveys were carried out in the vicinity of Kłodawa. These surveys have shown that there is a shallow hidden salt diapir in the area.

The Second World War interrupted research for several years. They were revisited after the end of hostilities, providing an outline of the large potash and rock salt structures. Construction of a mine and a processing plant for potash salts began, locating it in the middle section of the salt diapir. During the construction and the beginning of the exploitation of the deposit, it turned out that incorrect conclusions had been drawn during the surveys, as it was found that there was little potassium salt in the diapir, whereas it was a massive rock salt diapir. The first tonnes of rock salt were extracted in 1956. Two years later, as a result of a change in the production profile, the company’s name was changed – the “Kłodawa” Salt Mine was established.

The Kłodawa salt deposit was formed during the Zechstein period (about 200–250 million years ago) and rose to the surface in the form of a salt diapir (Fig. 5). The length of the salt diapir is about 26 km, while its width reaches almost 3 km.

The “Kłodawa 1” diapir deposit is located in the middle section of the Kłodawa salt diapir, at depths from about 450 m below sea level to about 1,000 m below sea level. The width of the diapir in the depositional zone varies from about 2 km to about 2.5 km. The north-eastern and south-western boundaries of the deposit are defined by the edge of the diapir, while the north-western and south-eastern boundaries are defined administratively, as the deposit rocks extend in a north-western and south-eastern direction beyond the “Kłodawa 1” deposit zone. Currently, the ceiling and bottom boundaries of the deposit are established at heights of 500 m above sea level (the bottom of the safety shelf) and 1,000 m above sea level (the documentation boundary). Due to the very steep orientation of the Zechstein rock banks in the deposit, above the ceiling boundary of the deposit the rock salts continue into the salt horizon, so the deposit is separated from the diapir cap by a ceiling shelf made up of rock salts. Also, below the bottom of the deposit rock salts occur, which presumably continue for several kilometres above sea level, i.e. to the foot of the Kłodawa salt diapir (source of information: geological documentation of the Kłodawa salt deposit).

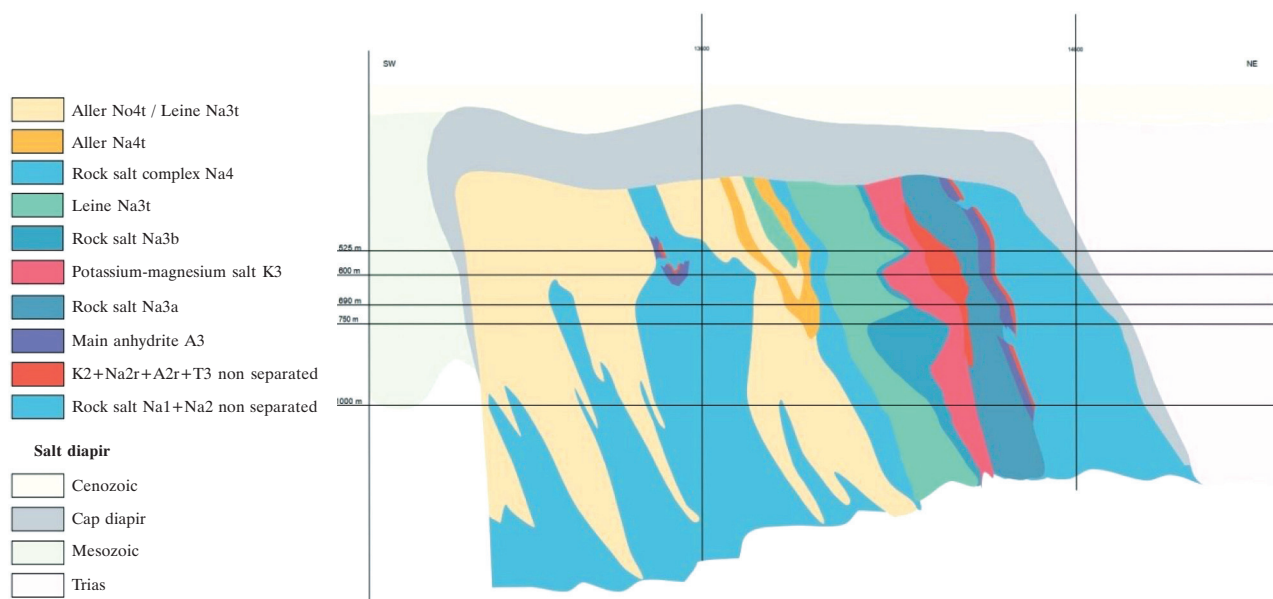


Fig. 5. Geological cross-section through the Kłodawa salt diapir (own materials of the “Kłodawa” Salt Mine [3])

Initially, the plant was intended to extract approximately 450,000 tonnes of rock salt per year. This level was reached in the late 1960s. The 1970s was a time of expansion of the mine. During this period, salt output reached over one million tonnes per year.

By design, the biggest customer for the salt mines was industry. With the industrial downturn of the 1980s and 1990s, the demand for rock salt fell and so did mining. However, the development of the road network in Poland over the past several years has increased demand for road salt, which has changed the sales structure of rock salt extracted from the Kłodawa mine.

The mine is a joint stock company where 89% of the shares belong to the Industrial Development Agency and 11% are held by employees and pensioners. The current workforce is around 770 people. The company holds a salt mining concession valid until 2052. Currently, Kopalnia Soli “Kłodawa” S.A. is the largest producer and supplier of rock salt on the domestic market. Production volumes in the last five years have ranged from around 350,000 tonnes to 870,000 tonnes.

Salt extraction is carried out using the traditional mining method, which makes it possible to fully preserve the qualities of Kłodawa salt created by nature. The company’s products are obtained through the mechanical processing of raw materials without the use of chemical treatments.

The Mine’s market position is mainly based on the sale of bulk rock salt to industry, road construction, salt licks and bagged and pre-packaged salt.

The products offered by the company are grouped as follows:

- bulk salt (industrial and feed),
- road salt – non-caking (DR, DS, DA),
- bagged salt (food, industrial, road salt) – packs of 5 kg and 25 kg,
- salt in big-bag packaging,
- pre-packaged salt (food grade) 1 kg and 3 kg,
- salt licks (made of natural rock salt and with mineral additives),
- salt crumbs,
- so-called minor confectionery,
- salt accessories (lamps, candlesticks, salt ornaments).

The mine’s products are differentiated not only by packaging but also by grain composition and additives such as potassium iodide in table salt or mineral additives in animal licks. Anti-caking agent is added to road salt.

The company’s area of operations is mainly Poland, where around 80% of the salt produced is sold, and this is the target market in geographical terms. The remaining dozen or so percent are mainly sold on the market of European countries.

Due to the strength parameters of the salt rocks, their specific nature and geological and mining conditions occurring in the salt diapirs, the exploitation of the deposit is conducted exclusively using the room-and-pillar system in the following variants:

- flat chambers with a stair-ceiling face;
- flat chambers with a stair-bottom face:
 - single-level,
 - multi-level.

At present, the flat chamber system, in which the chambers are cuboidal in shape with a horizontal longest axis, is used as the only means of salt extraction.

The chambers may be positioned longitudinally or transversely to the extension of the salt strata. Chambers made at the same level are separated by inter-chamber pillars, and at individual levels they are separated by an inter-level shelf. The dimensions of the chambers and inter-chamber pillars and the thickness of the inter-level shelves change with depth.

Up to the 600 m level, the deposit was mainly selected by 15 m wide, 15 m high and about 100–200 m

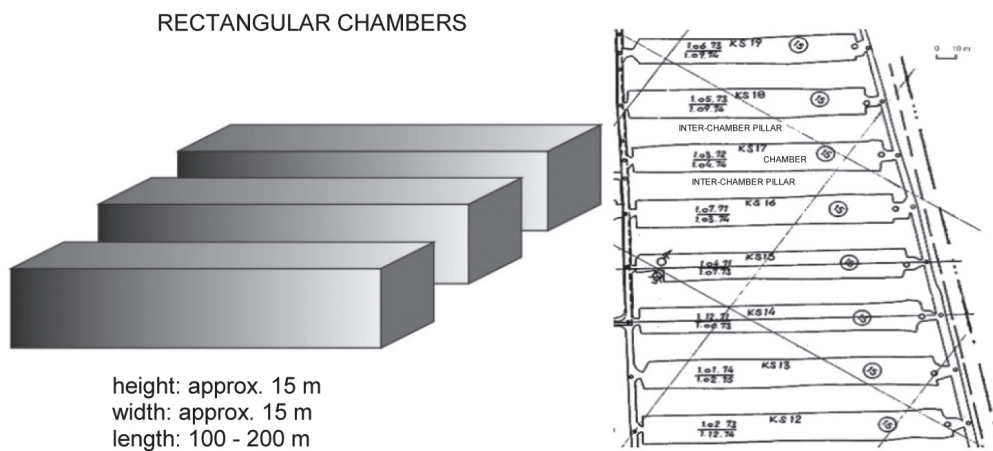


Fig. 6. Rectangular chambers (own materials of the “Kłodawa” Salt Mine [3])

Below level 600, the dimensions of the chambers decrease with increasing depth. Their width and height decrease, depending on the mining field, from 13.5 m to 12 m, while the width of the inter-chamber pillars and inter-level shelves increases. These changes occur in such a way that the vertical and horizontal field dissection modulus is at all levels below 600 m equal to 30 m. The length of the chambers varies from 50 m to 400 m. The lowest level of exploitation of the salt chambers is 810 m.

In connection with the geometry of the mining fields in fields Nos. 1 and 2 the axially of the chambers is preserved, while in fields Nos. 3 and 5 the mine has a deviation from the regulations regarding the non-overlap of pillar axes between the chambers of the lower level with the axes of the pillars of the higher levels in the depth range of 600 m to 810 m.

When mining with the chamber system in rock salt deposits, post-mining voids are not eliminated, i.e. the free space that arises after the mineral has been extracted. The chambers are designed to maintain long-term geomechanical stability. For this reason,

long chambers (Fig. 6). The length of the chambers in the transverse arrangement depends on the thickness of the salt layers being extracted and in the longitudinal arrangement – on changes in their extensibility and changes in their thickness. Adjacent chambers are separated by 15 m wide pillars and a 10 m thick shelf is left between successive inter-levels.

Thus, the modulus of the horizontal field dissection (the sum of the width of the inter-chamber pillar and the chamber) equals 30 m and the modulus of the vertical dissection (the sum of the height of the chamber and the thickness of the inter-chamber shelf) equals 25 m.

underground voids of considerable volumes remained in the mine.

To date, approximately 1,000 mining chambers have been excavated and the corridor excavations form a network with a length of approximately 400 km. The total volume of all voids exceeds 18 million m³.

The production technology consists in mechanical processing of the raw material by crushing, grinding and sorting. Selected products undergo an enrichment process. The mine carries out the packaging of its products itself.

5. SUMMARY AND CONCLUSIONS

For many years Kłodawa road salt has been known and appreciated by road managers not only in Poland. The “Lisal” brand of salt licks for animals has been produced and supplied to domestic and European farmers since the 1980s. The brand name “Kłodawa Salt” was created for food-grade and cosmetic salts. Apart from pure NaCl, table salt from Kłodawa con-

tains a number of natural macro- and microelements called “elements of life” by Prof. Julian Aleksandrowicz. Comparative research carried out in an independent laboratory has shown that “Kłodawa Salt” (from a nutritional point of view) is very similar in its chemical composition to “Himalayan Salt”, which has become fashionable in recent years. The Kłodawa salt diapir is the only one in Europe where, apart from white salt, pink salt is exploited (the closest to Poland pink salt is exploited in Pakistan). An interesting feature of the Kłodawa mine is the deposit of magnesium and potassium salts. It is from them that the “queen of Kłodawa salts” – Kłodawa Magnesium-Potassium Bath Salt – is created. Tested in the Department of Balneology in Ciechocinek and tested on a group of people with movement disorders, it gives excellent therapeutic results. The pink salt crumbs, unique in the world, are used for the production of salt accessories, such as lamps, chandeliers, etc., which create a unique atmosphere in rooms.

The Kłodawa salt mine is home to the deepest underground tourist route. The Kłodawa Underground Tourist Route is located at an excavation level 600 metres below ground level. The tourist route and selected geological sites have been entered in the register of historical monuments (Fig. 7). On 20 April 2007, a “concert at the lowest level” was held on the route. The musicians of the Kalisz Philharmonic played Antonio Vivaldi’s “Four Seasons”, which was recorded in the Guinness Book of Records as the concert at the greatest depth.

More information about the route and the possibility to visit the Mine as well as the products can be found on the company’s website [1]. In addition, it is possible to purchase mine products from the mine’s online store.

Observation of the changes taking place in the salt market over the last twenty years or so leads to a number of conclusions:

- Analysis of recent years shows a fairly stable demand and supply of brine and evaporated salt.
- The rock salt market, whose main use is for winter road maintenance, is characterised by high volatility.
- In the forecast of the coming years, one should expect a continuation of the slight upward trend in salt consumption in the chemical industry and a stabilisation of salt use in the food and feed industry.
- Due to the planned further development of the road network in Poland by 2030, road salt consumption may double in ten years’ time to approximately 3.0 million Mg (however, this will depend directly on the prevailing weather conditions during a given winter).
- Due to the limited production capacity of Polish producers, it is necessary to expand the network of warehouses for road salt in order to avoid crisis situations during winter periods. The creation of cyclical strategic reserves of road salt will enable Polish producers to produce evenly and reduce the degree of dependence on imports.
- Particularly dangerous is the gradual dependence of the winter road maintenance market in Poland on salt producers from Ukraine and Belarus.
- With the development of the road network in Poland, the potential demand for road rock salt will also increase and the current production capacity of the two Polish mines is limited. It is therefore necessary to prepare for the question “Where will we get rock salt from in Poland in the coming decades, and especially after 2052, when the concession for rock salt mining in Kłodawa comes to an end- (imports, KGHM, construction of a new underground mine).



Fig. 7. Salt chambers of the Kłodawa Underground Tourist Route (own photos by “Kłodawa” Salt Mine [4])

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