district heating

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District Heating in Wels, Austria

Safety Drains to Prevent Flooded Heat Exchangers

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DISTRICT HEATING OF A SMALL TOWN IN AUSTRIA

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Wels is an old, small town in the county of Lower-Austria. Since November 1959 a modern combined power and heat generating plant has been in operation, one of the first in Austria. At the time of starting operation of the district heating system in 1959 the town contained about 41,000 inhabitants, which number has increased today to 44,000. The decision to build the district heating power plant had been taken by the directors of the Electricity Works Wels A.G. in 1957. This establishment has operated for 50 years a water power station on the river Traun, outside the town. After 1945 this station had been fully modernised and was equipped with new hydraulic water turbine alternator units. The upper limit of electric supply was, however, limited at 6,400 kw. During the last decade or so the demand for electrical energy within the boundaries of the town increased considerably. Investigations revealed that a notable demand for heat supply existed in industry and for space heating. This suggested the idea of building a combined heat and power station for district heating.

It was decided to base the project on a heat capacity of 30 million k cal/h (120 million Btu/hr) and a generation of 8,500 kw. According to the administration of the present power station there exist definite plans for building new blocks of flats and other buildings at Wels. This indicates an additional demand of about 30 million k cal/h, which will require doubling of the present heat capacity. As regards electrical power the present position is that the whole output from the power station is being consumed. An adequate increase of power output will thus become necessary.

The present plant consists of two steam boilers manufactured by Waagner-Biro of Graz. Firing is possible with lignite, and also with residual oil and with natural gas. All three fuels are obtainable in Austria. The normal capacity of a boiler is 24 ton/hr max, continuous 30 ton/hr. Steam of 64 atu pressure (940 lb/sq in.) and 480 C (896 F) super-heat supplies the power units.

A water treatment plant deals with raw water piped from a deep well. The water is first chemically softened, and then preheated, 104 C (219 F) in the pre-aerator, and 140 —160 C (284-320 F) in the following main unit heated by turbine steam. Air for combustion is preheated in an air heater up to 280 C (535 F).

The steam boilers have been designed as two-draught units with one drum and natural circulation. In the combustion chamber are located: (1) two burners for pulverised lignite on the front wall; and (2) two combined oil and gas burners on each side wall. A Luvo filter cleans the flue gases. The chimney had to be only 50 metres (164 ft) high due to architectural and constructional circumstances, which made induced draught necessary.

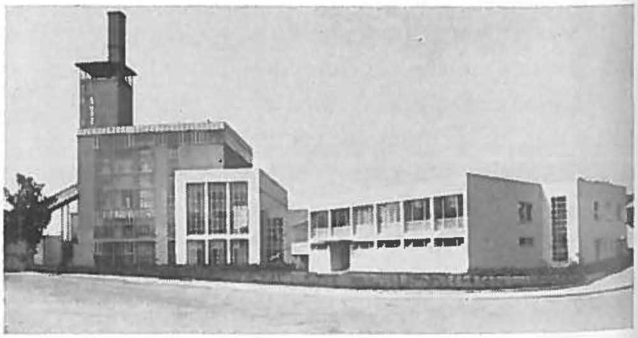
The power units consist of a steam turbine of 8,500 kw. Turbine and generator are directly coupled. Steam is supplied at 56 atu (822 lb/sq in.), and 465 C (870 F) to the turbine inlet normal; and 64 atu (940 lb/sq in.), 480 C (896 F) max. Steam for district heating is supplied from the turbine at 5 atu (73.5 lb/sq in.) pressure via a controller. The residual steam is utilized in the medium and low pressure stages for power, and is finally condensed. Three high-pressure pumps feed the boiler group, and draw the water from an accumulator. An economiser preheats the feedwater. The A.C. Synchrone generator has a capacity of 10,000 kva, at 3.3 kv. A D.C. transformer and a 10 kv distribution unit supply electric current to the town districts.

Heating mediae for the district scheme in Wels are hot water and steam. The hot water is generated in cascade heaters using steam for an intermittent turbine stage. Flow temperature is normal 140 C (284 F) at minus 20 C (—4 F) outside temperature. Return temperature is 80 C (176 F) max.

There existed numerous low-pressure steam piping systems in Wels at the time of planning. In order to utilise these, an auxiliary low-pressure distribution system has been installed parallel to part of the H.W. piping. Steam pressure is 1.1 ata (16 lb/sq in.) and supply comes from the turbine at controlled condition. Condensate from the steam-warm water converters (heat exchangers) in the distribution system runs under pressure into a central condensate vessel. Special pumps feed the hot condensate into the warm water return piping.

For the first time in Austria an isolating material for the district heating pipes has been used consisting of granulated particles, concrete and other additions. This was specified in place of the conventional concrete channels, and the pipes have been buried freely in the soil.

According to Dipl. Ing. E. Werner, Director of the Municipal Power Station, Wels, the problem of installation of the district piping system demanded an efficient and economical solution. A novel method has been used, which up to now has worked very well indeed. Based on years of practical experience in Germany, the so-called "Aero-Crete" insulation material has been selected, developed by Messrs. Kempf, Neuss/Rhein. The engineers of the district heating



Power station and administrative offices.

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power station decided to bury the whole lengths of the piping system direct in the soil by exposing the Aero-Crete to resist corrosive and other attacks. The saving of excavation space was considerable, and the cost of the whole piping system was reduced. Aero-Crete is a mixture of particles 0-15 millimetres (5.9 in.) of a special stone material (of pen-size pellets) with cement. Addition of a pulverised substance which expands when exposed to humidity and at the same time produces a water-tight surface where moisture is present. The mixture is prepared in mixing vessels, and is then filled between walls like concrete. Depending on quality, the Aero-Crete can be used after several hours or days. About 60 tons per cubic metre (46 ton/ cu yd) can be achieved. Capacity of insulation ranges similar to glass wool coefficients. It is claimed that experience is satisfactory.

SOME TECHNICAL DATA

The section for supply of heat to the district deals with a normal hot water circulation of 500 tons/hr at max 100 m (328 ft). Pumps for boosting up pressure could be installed if and when required. Length of hot water piping is 6.3 kilometres (3.8 miles), and of steam, 2.1 km (1.8 miles). Diameters of hot water piping varies from 80 to 400 millimetres (3.14 in. to 15.7 in.) and steam piping diameters rise up to 175 mm (6.88 in.). U-type expansion units are used, and have been selected as the best and most economical solution for local conditions. Isolation of the U-pieces and of the supply pipes to dwellings and other buildings is performed by use of glass wool.

MEASUREMENT AND CONTROL

Mr. J. Patzelt of Siemens & Halske G.m.b.H., Vienna, describes in some detail the relatively simple means for measurement and control at Wels. A supervisory instrument panel contains S. and H. instruments for steam turbine, pre-heater and electrical generator. The boilers are automatically controlled by means of a centralised panel. Combustion control is based on pressure differential between boiler drum and exit from superheater. Superheat is controlled by using a vessel with spray cooling.

The electrical instrumentation, such as high-voltage distribution and safety of generators, is of Brown Boveri design.

THE CALIQUA HIGH-TEMPERATURE HOT-WATER SYSTEM

Dipl. Ing. H. Wenzel from the Caliqua Company in Vienna describes the circulation system used. It is a completely closed system, using a H.T.H.W. generator fed from turbine steam. The hot water generator (heat exchanger) is at the same time dimensioned to act as an accumulator to be ready for peak loads. Circulation is performed by one of the two installed pumps. One is driven by a small steam turbine, the other by electro-motor. The calculation and the design of the piping in the district, carried out by Caliqua specified careful performance of welding, and of X-ray testing, etc.

A FEW FINANCIAL CONSIDERATIONS

The financial director of the E.W.A.G. Wels, Mr. E. Dichtl, reviews financial aspects during consideration of the project and at the beginning of supplies of heat and power to the town. The opinions against and in favor of construction of a district heating scheme in a small provincial town in Austria have been very strong indeed. The fact was, however, that the steeply increasing power consumption demanded action. This and definite plans for municipal "council house estates" were favourable. Other expected advantages were use of low-grade lignite, less air pollution, less road traffic and storage for fuel within the town, and many more as compared with other space heating methods.

In the beginning it seemed pretty hopeless to secure long-term financial credits. Relief turned up quite unexpectedly in the form of a new law, allowing depreciation for tax purposes of 20 per cent for immobile new plants. This beneficial regulation and a law favouring generation of electricity by means of special concessions enabled the power company to increase its own capital resources (20 million Austrian schillings ($799,960). The three leading Austrian banks placed the required 30 million schillings ($1,199,970) at the disposal of the power company at reasonable interest, and for ten years.

The decision to build was taken in the second half of 1957. Unfortunately, the actual required capital investment was ultimately about 30 per cent higher than estimated, namely 75 instead of 57 million Austrian schillings ($3,003,000 instead of $2,282,280).

The reasons for the considerable increase in expenditure are as follows: First, the increase in building plots caused by speculative manoeuvres. The final choice of a plot on the West section of the town necessitated not only building of a bridge for piping over a river, but also additional cost caused by a bomb crater, which latter was loosely covered with earth and was not detected until the foundations were started.

The introduction of the 45-hr week in the building industry, and the consequent increase of wages and materials by 5 and 6.7 per cent respectively, added to the total cost increase. Bad weather prolonged the building time and the expenditure for this item. Another unexpected item was an increase of 26 per cent in the cost of steam turbine equipment, caused by payment of import duties and some form of special tax. The power company expected a duty free import, but this was refused by the Austrian Ministry of Commerce. Another increase has been in time for installation and in standard costs for same.

The electrical plant section required nearly 72 per cent additional cost, partly caused by installation of a block transformer for the generator capacity. Considerations of prominent atmospheric disturbances and danger of lightning in the valley in which Wels is located made this additional expenditure necessary. An increase in the size of the equipment for distribution of electrical energy contributed to the higher cost.

According to latest news the plant is not profitable yet, because the tariff is the same as for other Austrian combined heat and power plants. Nevertheless, the plant works well, and supplies heat and electrical energy as required.

The conclusions to be taken from the above for this country seem obvious: technically the building and use of district heating systems are possible and plausible even for small towns. Financially great caution is required not to overstep preliminary estimates for total cost. Finally, assistance from the Government is required, but this will be repaid in time by increased economical developments in towns using district heating.+

Acknowledgement for data and permission to publish goes to the Directors of Wels Power Station. Bibliography: OZE AUSTRIAN JOURNAL FOR ELECTRICITY ECONOMY, *No. 8, 1960;* THE HEATING AND VENTILATING ENGINEER, *No. 10, 1964.*