Abridged version

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Overseas Engineering Operations

Kawasaki Steel's Experiences and Features of Overseas Electrolytic Tinning Lines

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Synopsis :

Kawasaki Steel started the operation of its first ETL (electrolytic tinning line) at Chiba Works in 1967. And based on accumulated operation know-how of ETL, engineering division started to supply ETLs to the Southeast Asia countries. The number of ETL which Kawasaki Steel supplied to these countries reached up to 9 lines. ETL has a production capacity from 60 000 t/y to 150 000 t/y. Some of ETLs are designed to be linked with shearing lines. Kawasaki Steel's experiences of ETL constructions and features of the equipment are discussed in this paper.

The body can be viewed from the next page.

Kawasaki Steel's Experiences and Features of Overseas Electrolytic Tinning Lines*

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1 Introduction

Up until around the 1950s, Southeast Asian countries relied on hot-dipping facilities or imports to meet their needs for tin products; since then, however, they have shifted their approach to increased local production by introducing electrolytic tinning lines (ETLs) that facilitate coating weight control and optimize light weight coating.

We have had two halogen-type ETL facilities in operation at our Chiba Works since 1967, and on the strength of operational know-how acquired and accumulated over years at these lines, our Steel Plant Group of Steel Engineering and Construction Division began to spearhead, starting in the early 1970s, the construction and operation of ETL facilities abroad and the transfer of their maintenance technology[1]. While the initial market was primarily Southeast Asia, we are now witnessing market expansion and diversification with recent orders received from China for two ETLs. This paper describes the features of facilities which we have either built or provided extended technical assistance for in the field of ETL.

2 Construction of ETLs Abroad

Over the past 20 years, we have built 7 lines of ETLs mainly for the Southeast Asian markets, and have extended our technical assistance to customers in other countries. In addition, 2 lines started operations in two different regions in China last year. **Figure 1** is a map showing different parts of the world where we have built or extended operational assistance for ETLs, while **Table 1** outlines our ETLs already built overseas.

3 Standard Arrangements of ETLs

We have three standard facility packages tailored for different production capacities, based on which we can determine equipment arrangement and line layout to meet the required production capacity. **Figure 2** shows standard ETL arrangements, and **Table 2** their core specifications. In cases where required production capacity is different from that of standard packages, one of the three packages which has the line speed closest to meet the required capacity is normally selected, which can then be used as a basis to design ETLs with different capacities by increasing or decreasing the standard number of plating cells. **Figure 3** indicates for each standard package an example of how production capacity can be varied by changing the number of cells. Here each curve represents production capacity where the ratio of products with even coating weight of 11.2 g/m^2

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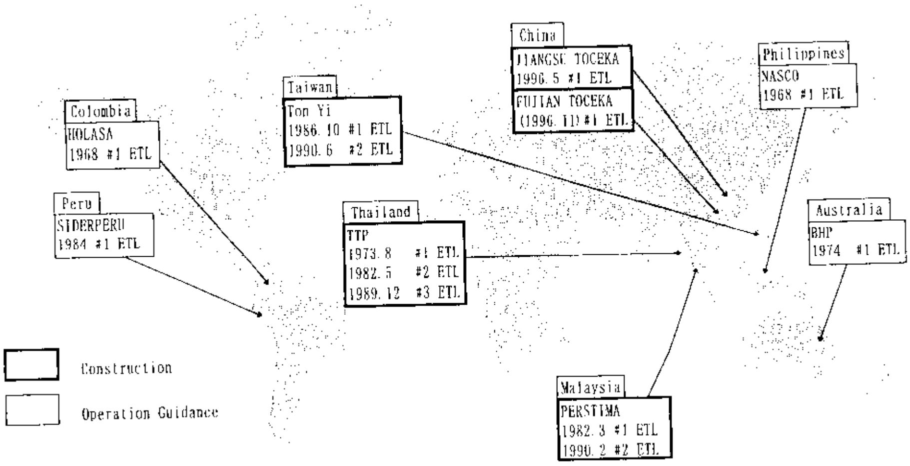


Fig. 1 Construction and operation guidance for overseas ETLs by Kawasaki Steel

Table 1 List of ETLs supplied by Kawasaki Steel

No.	Country (Company)	Start-up operation	Capacity (t / y)	Max. speed (m / min)	Plating cell (Number of tank)	Type of contract
1	Thailand (Thai Tinplate)	Aug. 1973	60 000	150	Top: 4 Bottom: 4	Full turnkey
2	Thailand (Thai Tinplate)	May, 1982	90 000	183	Top: 5 Bottom: 5	
3	Thailand (Thai Tinplate)	Dec. 1989	150 000	300	Top: 8 Bottom: 10	
4	Malaysia (PERSTIMA)	Mar. 1982	90 000	183	Top: 5 Bottom: 5	Full turnkey
5	Malaysia (PERSTIMA)	Dec. 1990	150 000	300	Top: 5 Bottom: 5	
6	Republic of China (Ton Yi)	Oct. 1986	60 000	150	Top: 4 Bottom: 5	
7	Republic of China (Ton Yi)	Jun. 1990	150 000	300	Top: 5 Bottom: 6	
8	People's Republic of China (JIANGSU TOCEKA)	May, 1996	150 000	300	Top: 7 Bottom: 7	
9	People's Republic of China (FUJIAN TOCEKA)	Oct. 1996	150 000	300	Top: 7 Bottom: 7	

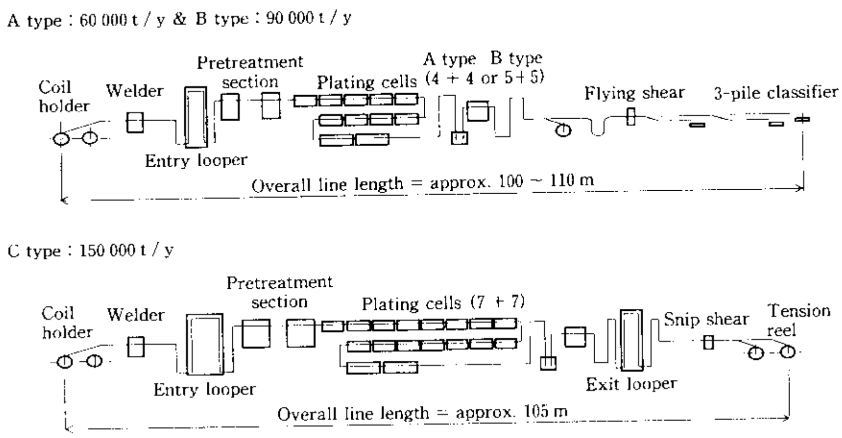


Fig. 2 Standard arrangements of electrolytic tinning line

Table 2 Main specifications of standard ETLs

Type	Nominal production (t / y)	Max. line speed (m / min)	Number of plating cell
A	60 000	150	4 + 4
B	90 000	183	5 + 5
C	150 000	300	7 + 7

Table 3 Standard maximum shearing speed

Type	Max. shearing speed (m / min)
a	150
b	183
c	230

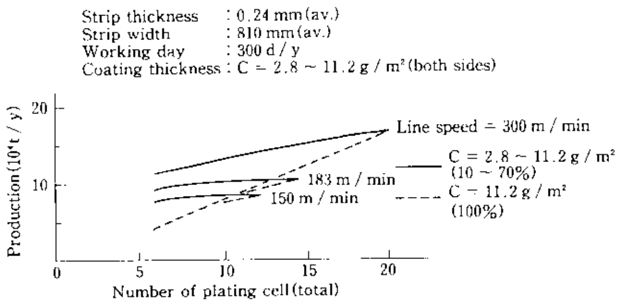


Fig. 3 Relation between production and number of plating cell

(one side) is set to 100%, and those between 2.8 g/m^2 and 11.2 g/m^2 (one side) to 70%–10%. It can be seen from the figure that with the material processing specifications and working days specified therein, ETLs with maximum production capacity of up to 170 000 t/y can be provided by standard packages. Depending on material specifications and ratio of coating weight, even higher production may be possible.

In the meantime, we have two types of facilities as standard patterns; an independent ETL in which raw materials are coated and reeled coil form, and a line which links ETL with a shearing line which cuts the coated strips longitudinally into sheet products. As shown in **Table 3**, which indicates standard maximum shearing speeds, the shearing lines are available in three types to ensure flexible design to meet varying customer requirements. And, in addition to the straight shears, scroll shear facilities can also be supplied.

4 Outline of Our ETL Technology

4.1 Halogen-type Horizontal Cell Electrolytic Tinning Technology

Halogen- and ferrostan-type are two mainstream electrolytic tinning technologies being used in the world today. Since our first ETLs at Chiba Works went into operation in 1967, we have continued to enrich our experience and operational know-how to fully utilize their excellent features. Halogen-type is superior to ferrostan-type in that, in operation, its horizontal plating system facilitates tin anode replacement and strip pass line observation and, in maintenance, simplifies conductor roll replacement and eliminates the need for sink roll at the plating section. **Figure 4** shows a schematic view of horizontal halogen-type tin plating.

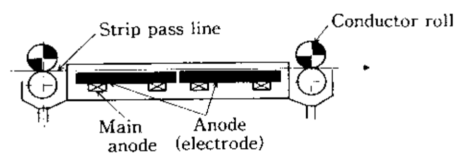


Fig. 4 Schematic view of halogen type tin plating

4.2 EOD (Edge Over Coating Defender)[2,3]

Electrolytic tin plating tends to generate high current density at the lateral ends of a strip, causing the coating of the plate to become heavier at the ends than at the center. Ever stricter quality requirements make it necessary to unify lateral coating weight. The conventional method used to meet such requirements involves the removal of excess coating weight by mechanical means after plating. In order to avoid lower yield associated with this method, we developed the EOD, which has already been supplied to ETLs abroad with successful results. **Figure 5** is a schematic diagram of our EOD.

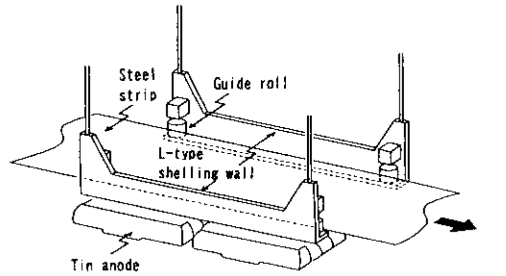


Fig. 5 Schematic diagram of edge over coating defender

4.3 CRP (Conductor Roll Polisher)[4]

At the electrolytic plating section, the surfaces of conductor rolls, to which external high current is applied, tend to attract metallic tin and sludge, and an excessive increase in such impurities results in reduced plating efficiency. This in turn varies coating weight and affects plate quality. On the other hand, removing them in the course of operation creates safety hazards.

To effectively cope with this problem, we have devel-

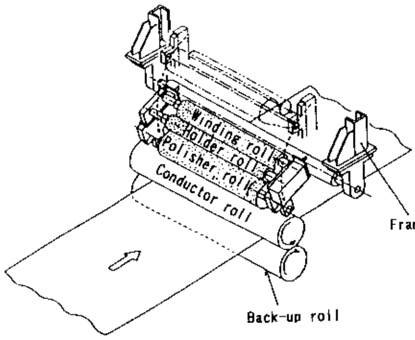


Fig. 6 Schematic diagram of conductor roll polisher

oped a CRP, or automatic conductor roll polisher, which helps to enhance quality and operation as it is adopted to an actual ETL. **Figure 6** is a schematic diagram of our CRP.

5 Our Comprehensive Capability

5.1 ETL Project System

5.1.1 From feasibility study to contract

Upon request of potential customers, we put our integrated program into motion, which runs from feasibility study to contract. Our program is tailored to allow full involvement with customers starting with an explanation of overall facilities that include plant layout plans, then continuing with a feasibility study of local production, furnishing detailed information and materials to answer inquiries for local construction work, submitting proposals for construction schedules, formulating personnel plans, acceptance education and training, and operating assistance. This integrated program enables us to provide project schedules that most effectively reflect the various requirements of project planners.

5.1.2 System tailored to contract

Our system is tailored to accommodate full turnkey contracts that include not only the supply of facilities but also required construction and test runs, and our years of experience testify to our ability to provide ETL facilities with high overall reliability. In other words, underlying our system to meet customer requirements is an integrated engineering capability that includes construction, procurement of facilities, installation, test runs and dispatch of supervisors after initial operation.

5.2 An Example of ETL for China

Now, referring to our recent experience of having built our first ETL in China, we will describe the processes that characterize our project flow. **Photo 1** is a general view of the ETL in China.

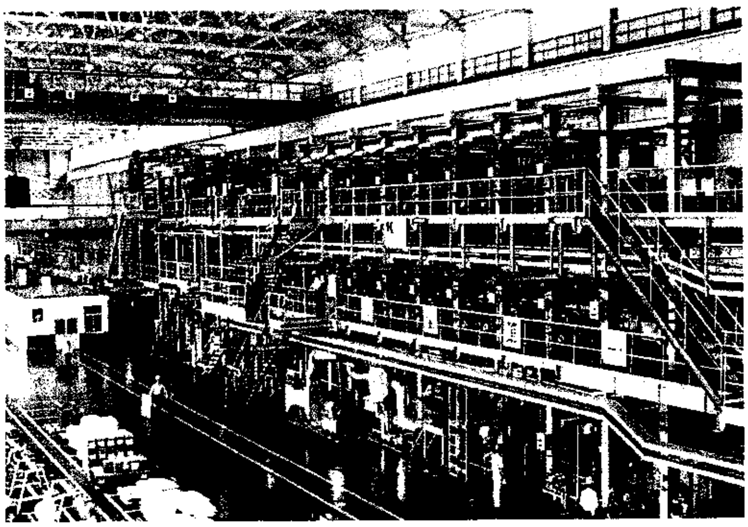
5.2.1 Project flow from planning to contract

It is quite natural for a client to seek, the earliest possible start of a project even at the stage where the project is still being visualized. It is no exaggeration to say that the working relationship with the client at this early stage determines the nature of the project. The planning stage of a project then primarily consists of client related activities such as applications for approval, coordinating project participants and feasibility studies, obtaining approval, and securing preferential measures. In the case of our China project, as with all other cases, we closely worked with the client from the time the project was first visualized to determine the framework of the project, and continued to assist him, reflecting his wishes wherever possible, until role assignment at the execution stage.

5.2.2 Procurement of facilities and equipment

It has been our standard practice to procure facili-

Photo 1 General view of ETL in China



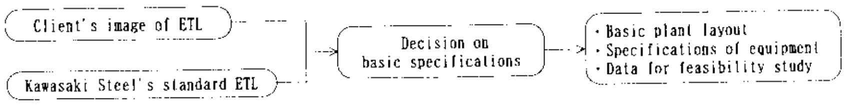


Fig. 7 Schematic flow of standardization of ETL

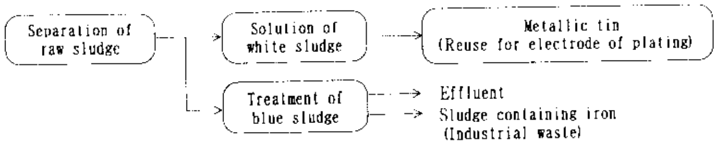


Fig. 8 Schematic flow of tin regeneration

ties for ETLs abroad from specific manufacturers with whom we have a close working relationship. Lately, to meet increasing requests from customers, a substantial portion of the facilities are being made locally (direct procurement by client) except those critical portions such as line facilities and parts related to electrochemical processes which have a direct influence on operational efficiency and product quality. Even for facilities and parts to be procured locally, we make it a point to prepare detailed drawings to ensure overall facility efficiency.

5.2.3 Construction

(1) Civil and Building Work

What generally determines the quality of construction is the precision with which facility foundations and electrical rooms are built. Since the accurate execution of work in these areas is indispensable for proper installation of facilities, even when it is not a turnkey contract, we have made it a part of our system to make a preliminary check of working drawings for facility foundations and electrical rooms, and dispatch civil engineers required in accordance with the engineering level of local contractors so that the overall quality of construction work can always be maintained.

(2) Installation

While the Chinese installation itself was executed under the supervision and responsibility of the client, about four month after the facility contract was finalized, we submitted a BQ (bill of quantity) for estimating construction costs. We also prepared for the client drafts of construction work contracts when necessary.

6 Future Development

6.1 Standardization of Facilities

By making the best use of our years of experience, we are proceeding with overall standardization of our ETL facilities so that we may be better able to grasp the needs of our customers and make faster and more competitive proposals for the further expansion of the ETL market. **Figure 7** shows a schematic flow of our ETL standardization process.

6.2 Sludge Disposal Technology

Sludge, which is primarily generated in a plating tank, contains toxic substances such as metallic tin, and its treatment, including the recovery of tin and separation of toxic substances therefrom, has been contracted out. Industrial wastes are to be used, for example, as fill-in materials for land reclamation. However, it is becoming increasingly important to minimize wastes at the source for enhanced environmental protection.

In the light of the above, we are developing a new sludge disposal technology for practical application in the near future. **Figure 8** shows a schematic flow of this new sludge treatment process, which separates sludge into recoverable metallic tin and harmless substances.

7 Conclusion

This paper has reported on Kawasaki Steel's supply records of ETLs to our customers abroad, and described the features of our facilities. On the strength of our accumulated experience in the field of ETL, we have established the basis which enables us to satisfy the varying needs of our customers such as their requirements for turnkey contracts supply of facilities and technological transfers. Our system is being further strengthened to meet efficiently and promptly requirements for ETL facilities in various markets including the countries of Southeast Asia. We are convinced that our technical expertise in the field of ETL can continue satisfying the needs of our customers.

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