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HUNGARIAN ALUMINIUMINDUSTRIAL Co.Ltd. By Shares
Ajka Aluminiumindustrial Co.Ltd.

F I N A L R E P O R T

on

Ajka Diecasting Plant development process

The projects have been supported by the British Know How Fund in the frame of UNIDO

Projects number:

PROJECT TF/HUN/903
TF/HUN/913

Ajka, May 1994.

FINAL REPORT

PROJECT TF/HUN/903
TF/HUN/913

1./ AIM OF THE PROJECT

The project aims at upgrading the technological and production capabilities of the Ajka Diecasting Plant in high-quality castings, improvement of efficiency, flexibility, product quality, increase of the foreign exhange earning potential und profitability of the Company through the establishment of a CAD/CAM system for the design of tools and simulating of the casting process.

2./ Motivation, Instification

The above defined strategy was an integral part of the consciously undertaken conception of Ajka Die Casting Plant. One of the major points of the mentioned was concept the manufacturing planning and product quality development. The attached paper New Developments in HUNGALU AJKA
ALUMINIUM CASTING PLANT deals with the essence of the conception.
Within the frame of the technical development the purpose was to establish an up to date manufacturing design system supported by high level hardware and software.

Scope of the project

The application of computer supported thermodynamic and metalflow design (fluid mechanics) system consists of:

- Introduction of computer aided casting die design
- Realization of CNC die manufacturing : Generation of NC code from CAD data base by means of CAM methods.

The UK based Delcam International Ltd. participated in the technical accomplishment.

3./ Fulfilment

The CAD/CAM system according to UNIDO project has been in operation since the end of 1993 as it is shown in Fig. 1. The objectives have been realised completly. This system is suitable to operate on world level and our engineers are able to develop the casting technology of the dies more optimal, to design surfaces with complicated geometry and to make NC-technology.
In spite of recession on the market we successeded in the production of new castings with especially complicated geometry, which partly could be done by applying CAD/CAM technology during this project.

Hardware and software means in details:

Project : TF/HUN/90/903
order No.: 15-1-0681 K

Hardware:

SUN SPARCstation 2GX	1 pcs
424 Mb HARDDISK, 24 Mb RAM,	19 " monitor
SUN SPARCstation IPC	1 pcs
207 Mb HARDDISK, 12 Mb RAM,	17 " monitor
1/4 tape drive	1 pcs

Software:

DUCTDRAFT	2 pcs
ADVANCED DD.	2 pcs
DUCT BASE	2 pcs

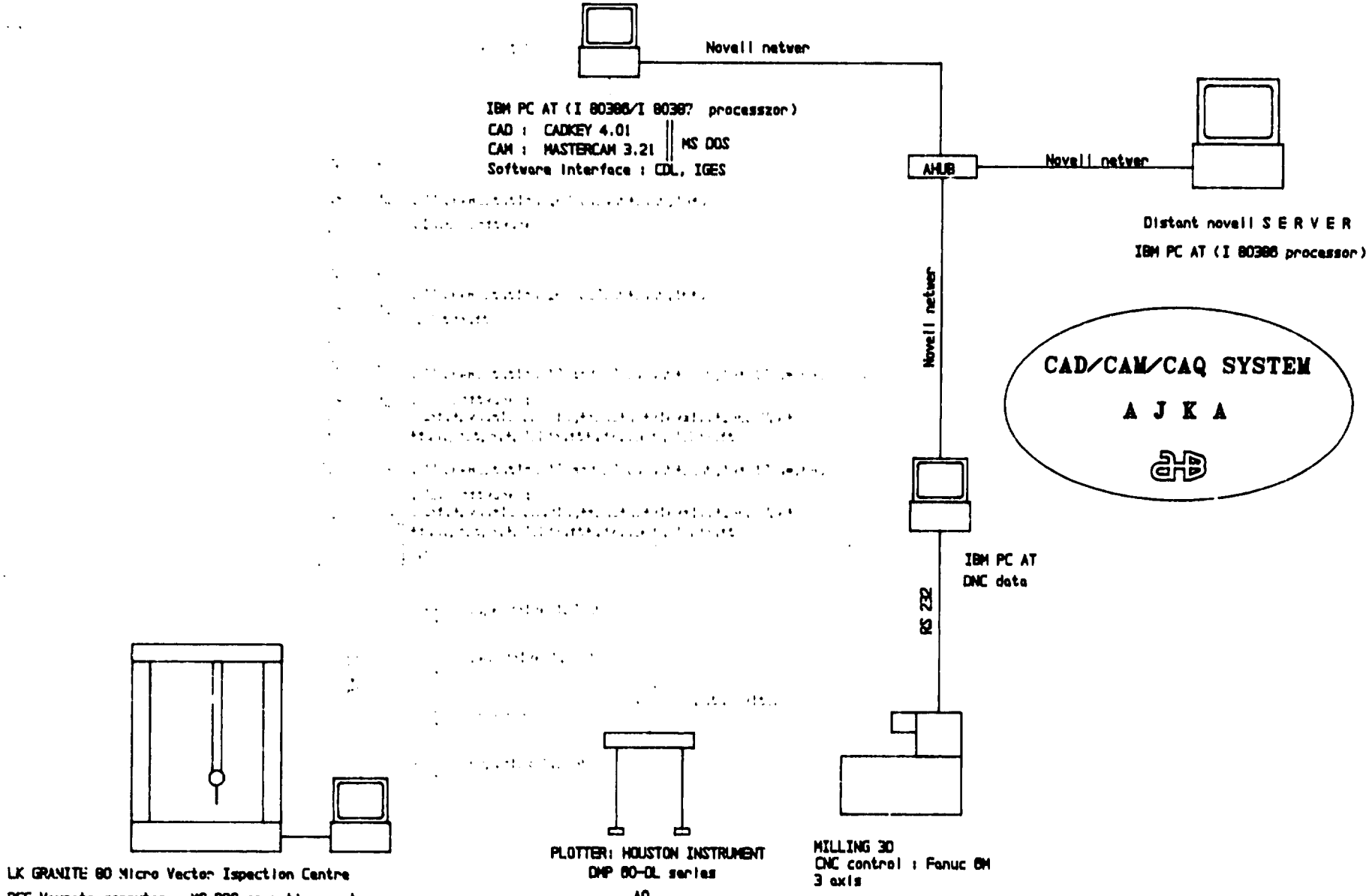
Novell netver
IBM PC AT (I 80386/I 80387 processzor)
CAD : CADKEY 4.01
CAM : MASTERCAM 3.21
MS DOS
Software interface : CDL, IGES
AHUB
Novell netver
Distant novell S E R V E R
IBM PC AT (I 80386 processor)
Novell netver
CAD/CAM/CAQ SYSTEM
A J K A
IBM PC AT
DNC data
RS 232
LK GRANITE 80 Micro Vector Ispection Centre
DEC Vaxmate computer - MS DOS operating system
CMES software
PLOTTER: HOUSTON INSTRUMENT
DMP 60-DL series
A0
MILLING 3D
CNC control : Fanuc 6M
3 axis

Fig. 1.

DUCT SURF	2 pcs
DUCT SHADE	2 pcs
DUCT NC	2 pcs
DUCT MSNC	2 pcs
DUCT VIEWMILL	2 pcs
DUCT IGES/VDA	2 pcs
STANDARD POSZT. PR.	2 pcs

PROJECT: TF/HUN/9L3
ORDER No: 15-2-0979 K

Hardware

SUN SPARCstation IPX	1 pcs
424 Mb HARDDISK, 24 Mb RAM,	19 " monitor

Software

CASTS-SIMTEC	1 pcs

- Automatic mesh generator
- Temperature field calculation
- Result representation
- DUCT/SIMTEC interface

5 x 5 Mb Additional RAM
1,3 Gb Expansion disk
644 Mb SUN CD pack
1,3 Gb DAT drive

Project: TF/HUN/903
Order No: 15-3-0686 W

Hardware

Upgrade SUN SPARCstation 2GX
to SUN SPARCstation 10 model 30 1 pcs
(424 Mb HARDDISK, 32 Mb RAM, 19 " monitor)

PROJECT: TF/HUN/90/913
Order No: 15-3-01687 W

Hardware

SUN SPARCstation 10 model 30 1 pcs
424 Mb HARDDISK, 42 Mb RAM, 19 " monitor

Software

Dynamic shading	2 pcs
Advanced DUCTDRAFT	1 pcs
DUCTDRAFT	1 pcs
PCNFS	1 pcs

4./ Instruction and training

We gave special atention to it, that our engineers can apply these modern resources on a high level and efficiently. During the training we gave preference to three tactical steps:

a./ to have a training in the original surrounding at the software manufacturer,

b./ to have an intensive practice at home,

c./ to have a consultation with the software manufacturer at home.

We determined the time necessity of these three steps depending on the complexity and specificity of softwares.
The training process can be seen in 1. and 2. Tables.
As a result of the efficient training strategy the first complex production technology made by CAD/CAM method was completed in December 1992 and the first casting hardening simulation in July 1993. (Fig.2-5.)

DUCT TRAINING

CLASS	LOCALE	PERIOD (WEEK)	PARTICIPANTS
1	Birmingham, DELCAM International Ltd.	7	Gyula Simon project manager (engineer) József Papp engineer
2	Ajka Aluminiumindustrial Co.	12	Gyula Simon project manager (engineer) József Papp engineer Ottó Vincze engineer
3	Ajka Aluminiumindustrial Co.	1	Gyula Simon project manager (engineer) József Papp engineer Ottó Vincze engineer

SIMTEC TRAINING

CLASS	LOCALE	PERIOD (WEEK)	PARTICIPANTS
1	Aachen, RWP GmbH	1	Gyula Simon project manager (engineer) Imre Nagy casting technologic engineer
2	Ajka Aluminiumindustrial Co.	12	Gyula Simon project manager (engineer) Imre Nagy casting technologic engineer Sándor Blaskó casting tehnologic engineer
3	Ajka Aluminiumindustrial Co.	1	Gyula Simon project manager (engineer) Imre Nagy casting technologic engineer Sándor Blaskó casting technologic engineer

Fig.2. 3 dimensional shadowy surface design of the casting Stützen for Siemens

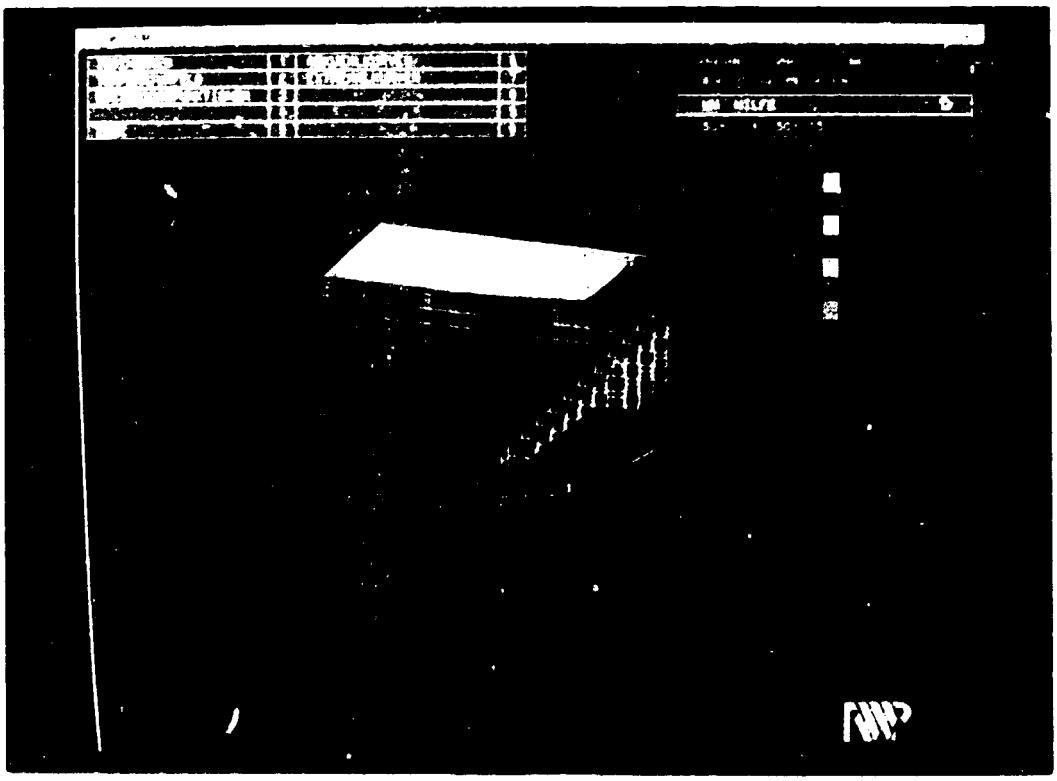

Fig.3. Solidification model I. of the casting heat exchanger for EURO-UNIOR

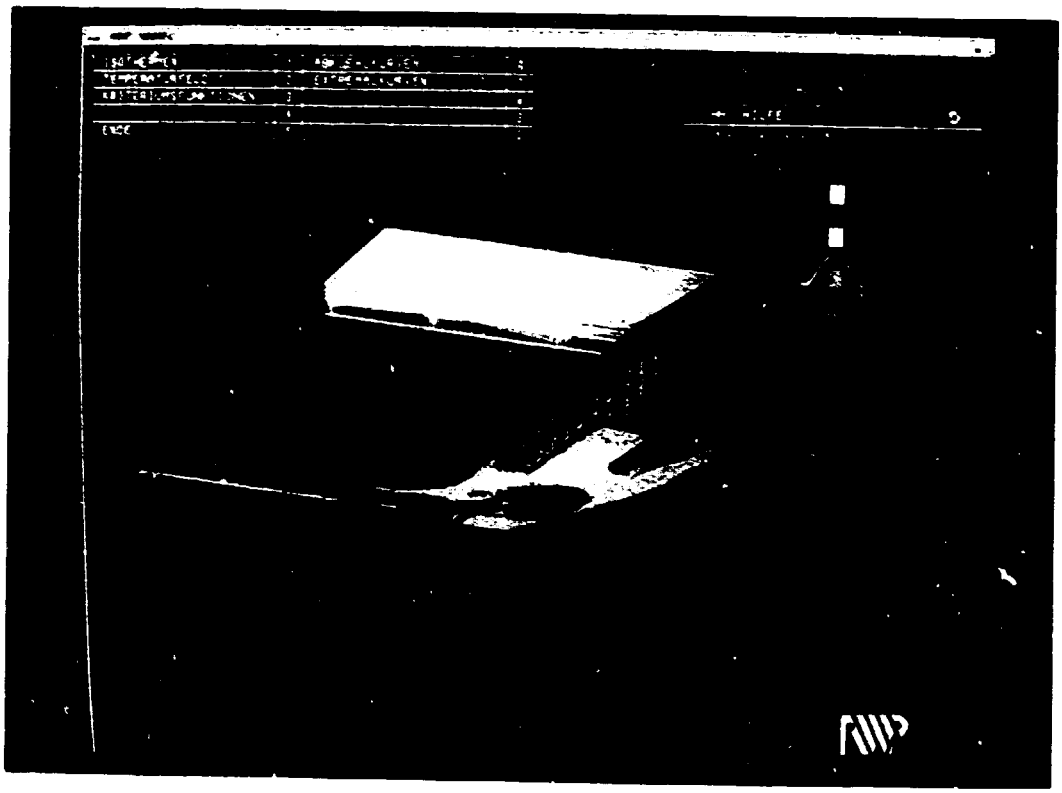

Fig.4. Solidification model II. of the casting heat exchanger for EURO-UNIOR

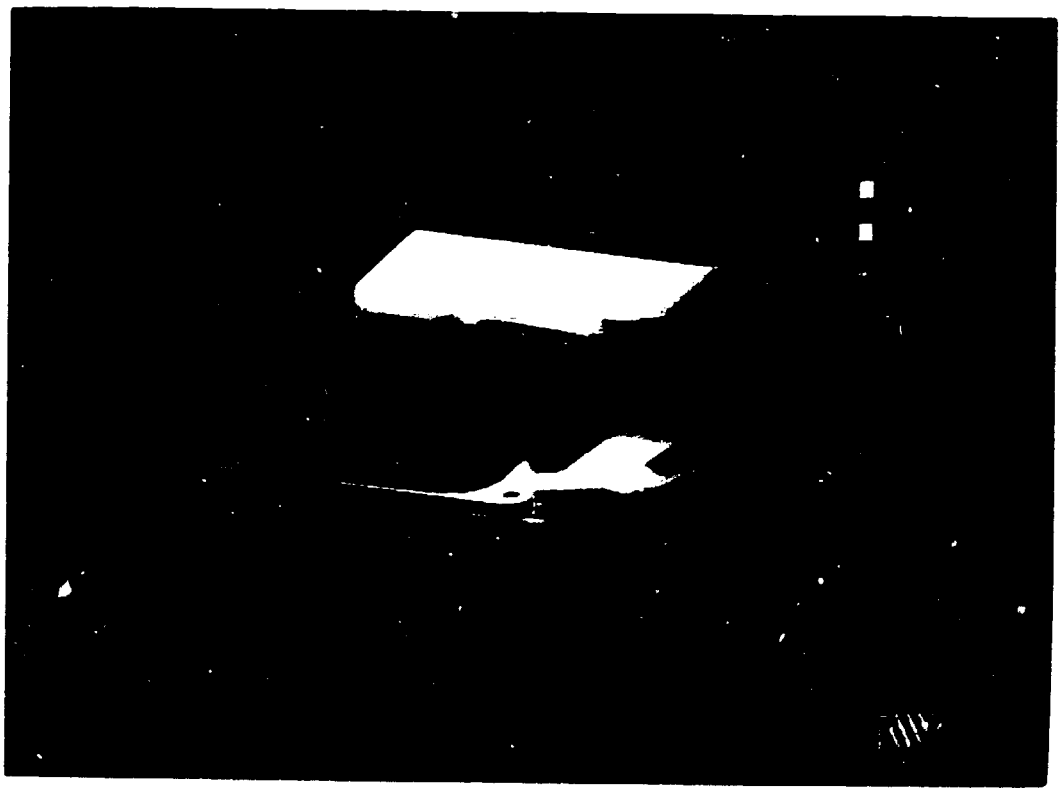

Fig.5. Solidification model III. of the casting heat exchanger for EURO-UNIOR

5./ POPULARIZATION, RECONNECTIONS

Our up to date knowledge we have obtained under the project, we shared with the domestic technical life stratum which had applied similar technology with us. Our British partner initiated in DELCAM international, we hold in June 1992 an open day, on which event the following institutes representatives have appeared:

Budapesti Műszaki Egyetem
Miskolci Egyetem
Veszprémi Egyetem
Győri Széchenyi Műszaki Főiskola
Csepel Művek Vas- és Acélöntöde
HUNGALU
RÁBA RT.
UNIDO
NEMZETKÖZI KAPCSOLATOK MINISZTÉRIUMA
IPARI ÉS KERESKEDELMI MINISZTÉRIUM

At present appears a good perceivable interest about DUCT and SIMTEC softwares.
Significant number of potencial buyer appeared at Ajka, and paralelly with this,DELCAM INTERNATIONAL has built up a Hungarian dealer business connection.

In our oppinion paralelly with the quickening of economy, more and more softwares can be sold in the widening Hungarian market.

6./ CONCLUSIONS

The project reached its goal.
The product quality in Ajka Die Casting Plant tool Diemaking Shop has improved, finishing, manufacturing, time have decreased and we have developed a tight and fuitful connection with the British know-how owner.

We acknowledge to British Government who has financed the project, and to DELCAM INTERNATIONAL LTD. for the good and effectual program arrangement, and to UNIDO for the good coordination, and the assistance of HUNGARIAN Ministry of Industry and Trade.

Géza Szalay
Director of Aluminium Division

7 th CONGRESS of INTERNATIONAL COMMITTEE for STUDY of

BAUXIT ALUMINA and ALUMINIUM

NEW DEVELOPMENTS in HUNGALU AJKA

ALUMINIUM CASTING PLANT

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Contents

INTRODUCTION

The Hungarian aluminium industry is integrated by Hungarian Aluminiumindustrial Limited Company by Shares from bauxit mining to producing finished goods.

Ajka Aluminiumindustrial Ltd. has two alumina plants with 480 kt/year capacity, an aluminium foundry (producing billets), a casting plant and a special products department (producing gallium, alumina and silica based products).

1. DESCRIPTION OF HUNGALU AJKA CASTING PLANT

Aluminium casting production was started in 1968 using gravity technology. Recently HUNGALU Ajka has about 3600 t/year capacity casting plant using three kinds of production technology.

1.1. Hiistorical background

The first aluminium in Ajka smelter was tapped in 1943 and cast into ingots. The aluminium diecasting shop began operating with gravity technology in 1968. This was followed in 1971 by the introduction of high pressure diecasting. Low pressure diecasting commenced in 1978 (1).

Reequipping with Italian made IDRA machines commenced in 1979. A new high pressure diecasting line with 2700 t/year capacity was put into operation in 1981.

The toolmaking shop was installed and equipped in 1979.

The present diecasting facilities enable Ajka casting plant to produce castings by all three technologies.

1.2. The existing production line

There are three production lines according to casting technologies ; gravity casting with 200 t/year capacity , low pressure casting (locking force is lower than 6 bar) with 300 t/year capacity and high pressure casting with 3100 t/year capacity.

It can be realised that high pressure manufacturing line is the most important.

1.2.1. Technical description

The manufacturing line has two WTFI tilting meltdown furnaces which are gas heated and have a charging well of 1000 kg/h for scrap melting and 10 t capacity.

Alloyed aluminium as raw material is produced using about 60 % of recycled material and 40 % of primary metal.

The gravity technology line has nine stations ; few of them have automatic control system , but the dies are hand fed. Castings weighing 150 g up to 7.5 kg are produced using this technology.

The low pressure technology line has four DIMO machines with capacity ranges from 60.0 kN to 76 kN , and they produce castings weighing from 3 kg up to 15kg.

The most important high pressure production line contains 19 machines with the locking force betwen 1600 kN to 12000 kN as Figure 1. shows. They are IDRA and BUHLER made machines , which can produce castings weighing from 5 g up to 25 kg. These machines are relatively well equipped with automatisation elements which are to be described in Chapter 2.

The castings are trimmed using REIS trimming presses of 100 , 120 , 200 , and 300 kN cutting force.

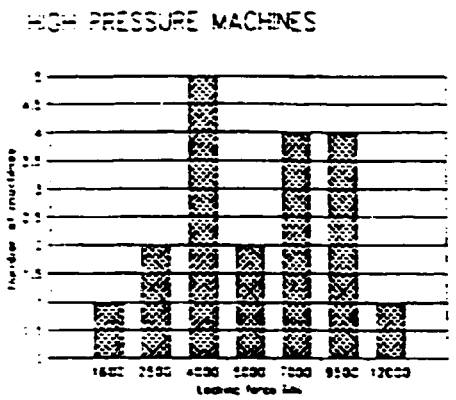

Figure 1. High pressure machines locking force

For giving the castings the appropriate surface different machines are available ; TAUSS vibratory tumbling , washing and drying equipment , TAUSS shot blast equipment , Joos belt grinding machines , TAUSS casting polisher.

1.2.2. Production and Sales

Production level of HUNGALU Ajka casting plant has been increasing according to Figure 2.

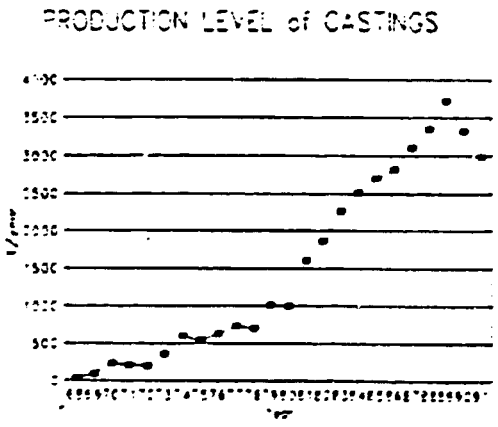

Figure 2. Production level of HUNGALU Ajka casting plant

In the middle of 80 s about 50 % of total production was exported to Western countries where the main customers are in Germany , The Nederlands , France , Schwitzerland , England. The main buyers are provided with reconciled well developed quality assurance system to meet their requirements.

Figure 3. shows the export ratio of castings produced.

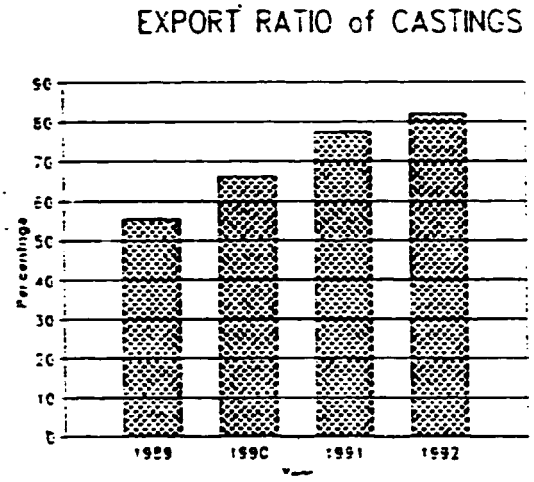

Figure 3. Export ratio of HUNGALU Ajka casting plant

As it can be seen the export ratio started especially increasing from 1989 when the domestic market demand started decreasing. The main foreign customers are in furniture , machinery , electronic and building industry.

2. DEVELOPMENT WORK IN HUNGALU AJKA CASTING PLANT

During the ten year operational period several modernizations have been taken.

The main reasons of these works were :

- to make the production process more effective
- to make the production portfolio wider

2.1. Automatization in high pressure production line

In 1989 an automatization investment process was launched to modernize the high pressure machines. It was a necessity, because the competitive export market needed better, stabil quality castings at a lower price level.

2.1.1. Equipment of automatization

Most of the 19 high pressure machines are equipped with automatic metal ladling, casting extraction and die spraying.

35 % of total equipment work fully automatically, which means that these machines are provided with:

- automatic metal ladling
- die spraying
- casting extraction robot
- hammer lubrication equipment
- die temperature stabilizator

Figure 4. shows a 4000 kN BUHLER totally automatized high pressure machine. The die spraying equipment was made by AECHESON firm, the casting extraction robot by BUHLER company.

Figure 4. Fully automatized 4000 kN BUHLER high pressure machine

During this high pressure automatization process 16 pieces of metal ladling , 5 pieces of casting extraction robot were installed , as they are summarized in Table 1.

Metal ladling	Machine type	Date of investment
1 piece	12000 kN	1990
4 pieces	9500 kN	1990
4 pieces	7000 kN	1989
2 pieces	5000 kN	1990
5 pieces	4000 kN	1990
Die spraying		
1 piece	12000 kN IDRA	1990
4 pieces	9500 kN IDRA	1990

Die spraying	Machine type	Date of investment
2 pieces	4000 kN Buhler	1990
1 piece	5000 kN Idra	1990

Casting extraction robot	Machine type	Date of investment
1 piece	12000 kN Idra	1989
2 pieces	7000 kN Idra	1990
2 pieces	4000 kN Buhler	1989

Table 1. High pressure machines automatization equipment (cont " d)

Most of the dies of gravity casting machines are operated by hydraulic cylinders. Few of these machines are equipped with computer control system developed in HUNGALU Ajka casting plant. This computer controls die opening and closing function and casting extrusion as well. The parameters of this control system (periodic time etc.) can be changed very easily by the caster because the series numbers are small meaning that dies need to be changed frequently.

Figure 5. shows an automatized gravity casting machine with computer control unit.

Figure 5. Automatized gravity casting unit

2.1.2. Practical experiences

Since every pieces of automatization additional equipment were bought from the professional firms which have a good experience in making them , the development process needed no more than six months after having the equipment. Installation work was made by the maintenance workers of HUNGALU Ajka casting plant.

After two year operation some statements can be settled :

- the hard physical work has been decreased and partly eliminated
- efficiency and productivity of labor force have been increased
- the life time of dies has been increased as well
- casting quality has been improved and constant quality can be assured
- quantity of die spraying and lubricant material have been increased ; unfurtunately.

2.2. CAD/CAM system in the toolmaking shop

When the new high pressure machines were established a new toolmaking shop was put into operation as well.

Practically all of the casting dies, trimming dies and fixtures required for the machining of castings are designed and manufactured by the company die department and few dies are exported as well.

2.2.1. General description

The die department produce about 80 dies and fixtures annually with a 120 m HUF (1.5 m USD) sales figure for different purposes.

This shop is equipped with the whole range of machine tools, including CNC machines needed for die and toolmaking. These include wire and copper anode spark erosion cutters, universal millers, jig borers, surface grinders, copy milling and pantograph machines, etc.

Die fitting tests are carried out on all dies made and they are undertaken on a REIS lapping press.

The separate section for designing the dies, tools and fixtures includes skilled design engineers with many years of experience in this field.

2.2.2. CAD/CAM development work

To stabilize the position of toolmaking in the competitive market few computer based systems have been established.

In 1990 a new English made three dimensional measuring banch was installed with computer control system which enables the toolmaking shop to determine all the geometric parameters of dies with very high precisity before fitting them , saving a huge quantity of work and time.

Figure 6. shows this LK GRANITE 80 Micro Vector Inspection Centre.

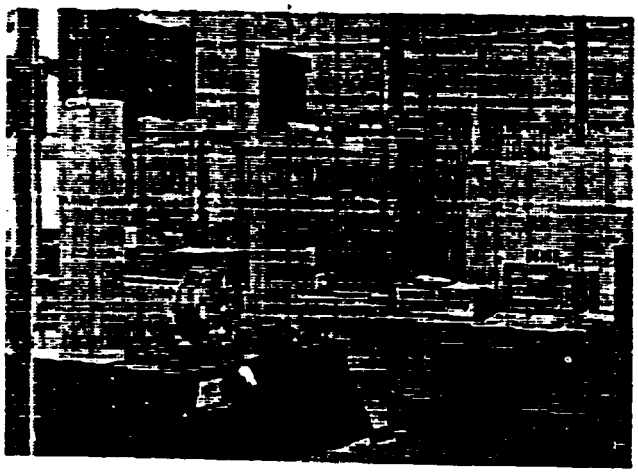

Figure 6. LK GRANITE 80 Micro Vector Inspection Centre

The toolmaking design section started using CNC technics in 1989 when few personal computers were bought with several software applications (CADKEY , MASTERCAM)

After having a good experience in using designing softwares a new three axis milling machine was set up , with direct connection (DNC) to the computers used in the design section. Practically a CAD/CAM workstation was created giving a good possibility for toolmaking specialists to improve their skills in this field.

In 1991 a new CAD/CAM/CAQ system was installed including SUN mainframe computers which enable using sophisticated three dimensional (3D) designing softwares.

Figure 7. shows the essence of this computer supported system which consists of the following elements :

- SUN IPC workstation
- LK GRANITE 80 Vector Inspection Centre
- few IBM PC microcomputers
- ETHERNET and NOVELL local network
- DUCD 5. three dimensional planning software
- CADKEY 3.55 and MASTERCAD softwares
- three dimensional millings (DECKEL , Fanuc 6M)
- several computer peripheries (displays , printers , plotters , serial ports , etc.)

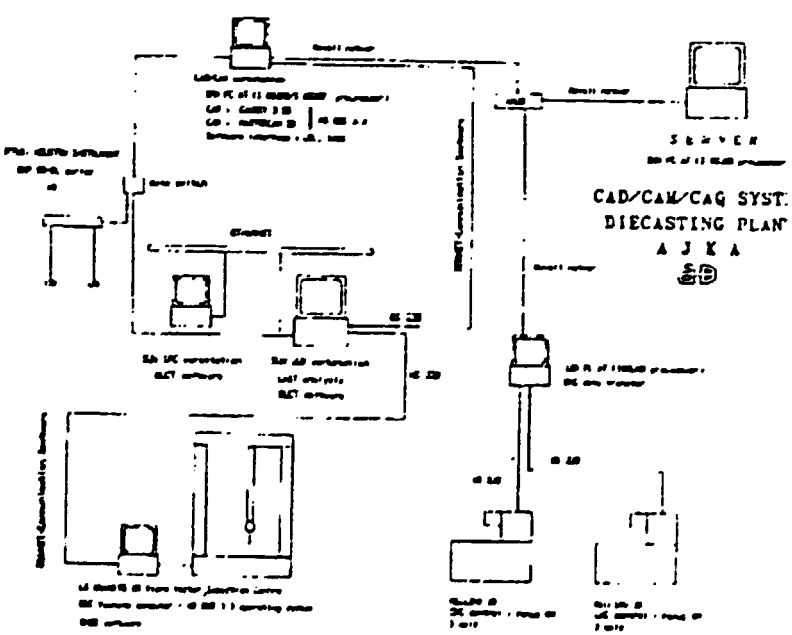

Figure 7. Toolmaking CAD/CAM/CAQ system

The newly established SUN IPC computer provides using a very sophisticated software named DUCT 5., which was developed by an English firm called DELCAM INTERNATIONAL.

The whole project was helped by UNIDO.

This DUCT 5. system enables the designer to develop a computer model of a product or component part on screen in three dimensions and to visualise the finished shape as a realistic shaded image. It then automatically converts the design geometry into cutter data for post processing into machining instructions so that the shape can be produced on a CNC machine tool with simultaneous control of up to five axis. The end res ılt which reproduces the designed shape precisely in every detail can be a model, prototype, pattern, electrode, mould, die or finished machined product (2).

Figure 8. shows a picture of this newly established CAD/CAM/CAQ system.

A new SUN 2 GX worstation with CAST analysis softwares and a new three dimensional milling are being established as well. The project is also supported by UNIDO.

Figure 8. The CAD/CAM/CAQ workstation in the toolmaking shop

3. QUALITY ASSURANCE SYSTEM

The aluminium casting competitive market and the Product Liability Act (which is going to be enacted in Hungary as well) needed to develop a quality assurance system. In the first step only the casting manufacturing line is being certificated.

In 1989 this quality assurance system development work was started according to ISO 9001 (EN 29001).

The essence of this work is summarised in Figure 9. which shows what kinds of works have to be made , and what the relationship is betwen these elements.

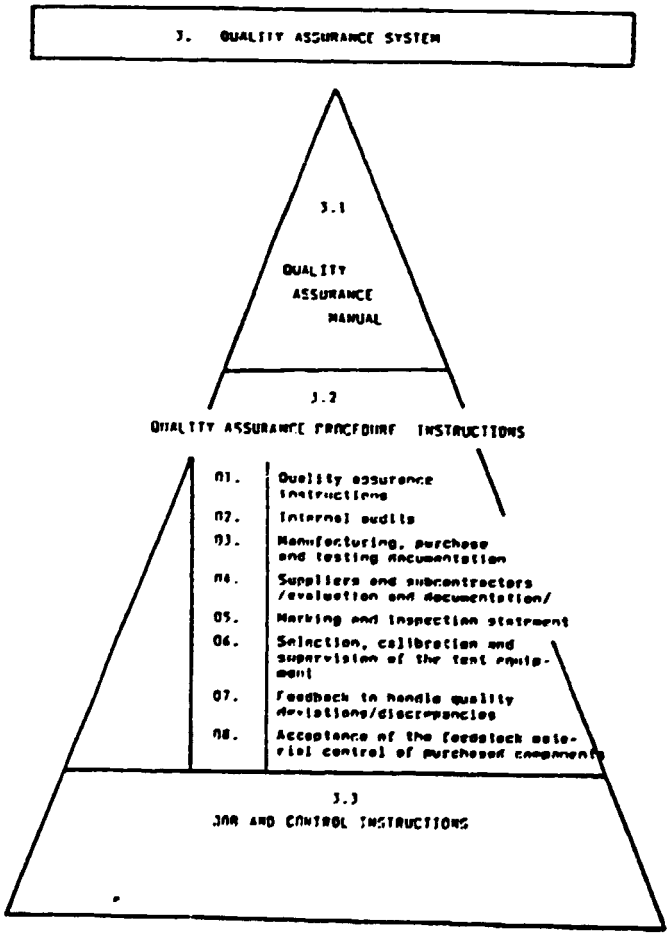

Figure 9. The essence of Quality Assurance System

In 1990 a Quality Assurance Manual was made by the help of TUV Rheiland which is the base of this development work.

In 1990 and 1991 many steps of quality engineering were made and the casting manufacturing line is to be certificated by TUV by the end of 1992 according to ISO 9001.

This certification process is to provide that HUNGALU Ajka casting plant can meet customer requirements in the future, can save the existing market share and can penetrate into other market segments (automotive industry).

SUMMARY

HUNGALU Ajka Aluminiumindustrial Co. Ltd has a relatively modern aluminium casting plant with about 3600 t/y capacity.

This study shows the existing performance of the casting plant, including production and sales figures.

The study outlines the development work made in the plant recently. The high pressure machines have been supplemented with automatic metal ladling system, die spraying and few of them with casting extraction robot. This automatization work has been analysed.

A toolmaking shop is connected to the casting plant, producing casting and trimming dies and fixtures as well. This shop is well equipped with different machine tools. A very sophisticated CAD/CAM/CAQ system has been installed to make the production process more economic and flexible, shortening delivery time. This development work has been shown in this study.

HUNGALU Ajka casting plant runs in the international, competitive market which needs that a quality assurance system is being developed. The process has been described shortly, which enable the plant to have a TUV certificated manufacturing line by the end of 1992.

These development works shown make the plant competitive in the next five years.

References

(1): The Aluminium Industry of Hungary. Diecasting and Smelter operations at the Ajka Works of HUNGALU

(2): Description of DUCT 5. software.

(Delcam report)