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NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1520
AND PRINTED IN BLACK INK.
THE TRADING AND DEVELOPMENT OFFICE

TRAINING PROGRAMME IN

THE IDENTIFICATION AND PREVENTION OF FAMOUS CASTING DEFECTS,

October 26th to December 23rd 1983

DF/TUR/77/024/11-03/B3/3.5.A

TRAINING REPORT

Prepared by

J.D. Hallinan M.A. M.I.B.F.
Foundry & Metallurgical Consultant

Export of the ITDG in collaboration with
The United Nations Industrial Development Organization acting as Executing Agency for
The United Nations Development Programme.

This report has been officially cleared with the United Nations
Industrial Development Organization, which does not therefore
necessarily share the views or opinions expressed.
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The Turkish Government Industrial Training and Development Centre (ITDC) is presenting a series of training programmes in an effort to aid the technological development of the Turkish foundry industry. This is part of its general assistance to Turkish Industry, undertaken in cooperation with UNIDO.

During the course of previous programmes in this series, it was observed that Turkish casting quality was often below that attainable. In part this can be attributed to insufficient understanding of the nature of casting defects and of how they may be avoided.

ITDC therefore planned and organised a programme on the subject of "The Identification and Prevention of Ferrous Casting Defects." This programme was arranged for the period October 24th to December 23rd 1983.

The emphasis in the training was strongly practical, and was oriented to the particular needs and problems of the Turkish foundries participating.

A set of written training material was provided for use in the training seminar and for subsequent translation and use as a reference handbook in foundries. These notes were specially prepared for the programme, and include a set of illustrations to aid defect recognition.

In accordance with previous suggestions, the programme was organised on a regional basis. A number of foundries was visited in each of the five major industrial regions of Turkey, in order to provide shop floor assistance and training, and to identify particular problems. The series of visits was followed by a short seminar in each regional centre, to provide more formal training, and to deal in detail with the individual problems identified. The seminars were illustrated with slides, and a film on loan from the Institute of British Foundrymen.

This regional approach proved to be satisfactory for the subject, and was welcomed by many of the foundry managers interviewed.

The programme proved to be successful, both in the content of the training provided and in the practical emphasis.

It is recommended that the programme be repeated from time to time.

It is also recommended that ITDC should provide additional programmes in future to cover a number of topics which were noted as being frequent sources of weakness and problems to Turkish foundries. Such topics would include core-making, runner systems for cast iron, and other related subjects.

Thanks are expressed to the staff of the ITDC, in particular the programme counterpart, to the management of many of the foundries visited, and to organisations which provided seminar facilities in the regional centres.

The success of the programme was due to the efforts of these people and organisations, and to the interest and enthusiasm of the participants.
2. INTRODUCTION AND BACKGROUND

2.1 The Turkish foundry industry is growing in capacity and importance. In 1982 approximately 400,000 tons of ferrous castings were produced, an increase of nearly 20% on the figure for 1980. In accordance with national economic policy the industry is endeavouring to develop direct export sales, and indirectly to assist in the exports of finished components and machinery.

2.2 The industry faces a number of problems, many of which are associated with limitations of technical knowledge and experience. Attention to these problems has been recommended by the industry itself, and by outside bodies such as the TSKI (Turkish Manufacturing Industry Development Bank).

2.3 The Turkish Government Industrial Training and Development Centre (ITDC) supported by UNIDO for the UNDP, is conducting a series of training programmes for the foundry industry, in an effort to assist in the technical development of the industry.

2.4 During the course of previous training programmes undertaken in Turkey as part of this ITDC effort, it has been noted that casting quality is often unsatisfactory. Castings may be sold and accepted even though they carry defects which could have been prevented. The level of internal rejects is often very high, so that operating costs and energy consumption are increased.

Turkish foundries frequently blame raw material difficulties for their quality problems. Some local materials do present disadvantages, but as has been established during previous programmes - these can be overcome if proper attention is given to technical control. Training is needed, at all levels, to indicate and reinforce the knowledge of the practical steps that can be taken.

At the conclusion of previous missions it was suggested that a training programme in defect recognition and prevention would serve a useful purpose.

2.5 ITDC therefore decided to include a training programme on this subject in their schedule of assistance to the foundry industry in 1983.

Emphasis was to be given to the practical aspects of the subject.

Terms of Reference were prepared and issued as part of the official Job Description (attached as Appendix I).

2.6 Previous experience with ITDC programmes for the foundry industry has shown that particular value is obtained by visits to individual foundries so that problems can be discussed on site, and shop floor training can be reinforced by practical demonstration.

There is also a need for more formal seminar or classroom training, which must be integrated with the programme of visits. Attendance at such seminars is sometimes limited by the ability of small and medium sized companies to send key personnel away from the foundries for long periods.

2.7 It was therefore proposed that the maximum value would be obtained if the programme were to include a large number of foundry visits followed by one- or two-day seminars in each of several regional centres. In this way the best use could be made of the experts' time, and it would be possible to direct the content of the seminars to meet identified local problems. It was also hoped to be able to attract more senior technical staff.

The programme was organised accordingly.
In order to make the most effective use of the time available, it was agreed that the training material would be best prepared in the expert's own country. A two-week period was allocated to this activity.

A set of notes was prepared in a form suitable for use as seminar course notes, and also for use as a practical reference guide for foundry use.

The identification of defects requires the use of illustrations to aid in recognition. For this purpose a number of examples were selected from British and other foundries, and a set of slides and illustrations for the notes were prepared. Use was also made of illustrations from published material.

The original suggestion was that the notes should be translated into Turkish by ITDC during a gap of some weeks between preparing the material and travelling to Turkey to commence the programme. In the event the time available in the scheduled period did not permit this; the notes will have to be translated at a later date.

In view of time limitations, and the fact that previous ITDC training programmes had been carried out relatively recently, UNIDO agreed to waive the normal formal Briefing meetings at Vienna Headquarters.

Therefore as soon as the training notes had been completed - the first section having been airmailed to Turkey at the conclusion of the first week of preparation work - arrangements were made to travel to Ankara directly.

On arrival in Turkey introductory meetings were held with SIDFA at the UNIDO offices, and with ITDC General Director and Project Coordinator and other senior staff.

Official Contacts are listed in Appendix II

The official Programme Counterpart was Celaletin Karabayer of the ITDC Metallurgical Department. The success of the programme must in large part be attributed to his efforts.

He, together with N. Ziya Tunç also of the Metallurgical Department, and Turker Aykal, the Chief of the Department, arranged the details of the programme schedule. At the same time the notes were transcribed and duplicated, together with the illustrations, for issue to the participants.

Visits were arranged to each of the three main types of foundry in Turkey:

Public Sector - Founndries as divisions of manufacturing organisations in the State owned sector

Private Sector - Large and medium sized foundries, either independent companies or divisions of larger Engineering groups. Visits were arranged to large, well equipped mechanised foundries, and to smaller less capital-intensive plants. Both iron foundries and steel foundries were included.

Small Scale - Privately owned small scale companies, employing little modern technology, and with relatively primitive facilities, producing simple castings for limited markets.

The visits were grouped into each of five main industrial regions of Turkey: ( Izmir, Bursa, Kastahir, Istanbul and Ankara ) In each region a seminar was arranged for one or two days at the conclusion of the visits.

The details of the programme are set out below.
MISSION PROGRAMME

24th October to 5th November
7th November
8th November
9th November to 10th November
11th November
13th November
14th November
15th November
16th November
17th November
18th November
19th November
21st November
22nd November
23rd November
24th November
25th November
26th November
28th November to 29th November
30th November
1st December
2nd December
5th December
6th December
7th December
8th December
9th December
10th December

Preparation of Seminar Notes and Training material. First section airmailed to ITDC.
Travel to Ankara
Meetings with SADI and ITDC Project Coordinator. Arrange Mission programme.
Supervise and edit transcription and reproduction of Seminar notes.
Checking of projectors and training material.
Visit to Türk Traktor Fabrikası, Ankara.

Travel to İzmir
Visit Pınar Döküm and İAC Foundry, İzmir
Visit Orsan Foundry, İzmir
Visit Şafak Döküm, İzmir
Visit Akdöküm, İzmir
Seminar for participants from İzmir, at Pınar Döküm offices.

Travel to Bursa
Visit Burçelik Foundry, Bursa
Visit Döktas Foundry, Orhangazi, Near Bursa
Travel to Eskişehir.
Meetings with Regional Officer, Ministry of Industry, and Secretary of Chamber of Industry to organise programme details.
Visit Anadol Döküm etc.: small scale foundries in Eskişehir.
Visit E.L.M.S. Foundry, Başelik, and Deniz Döküm Foundries, Eskişehir
Visit Entil and Eskişehir Şeker Fabrikası Foundries, Eskişehir
Further visit to Entil Foundry
Presentation of Seminar for participants from Eskişehir, at Chamber of Industry Offices.

Travel to İstanbul
Visit Elmėt Foundry
Visit Dökyöl Foundry
Visit Koçazici Döküm Foundry
Visit Dökümay Foundry
Visit Iral Çelik Foundry
Second visit to Elmėt Foundry
Visit Ferro Döküm foundry
Presentation of Seminar for participants from İstanbul district, at Chamber of Industry
Travel to Ankara
11th December to 17th December
Commence drafting Final Report

12th December
Visit Doksan Foundry

13th December
Visit Erkunt Foundry and Yazar Pump Foundry

14th December
Presentation of Seminar for participants from Ankara District, at ITDC offices.

15th December
Visit EKB Foundry
Complete Final Report

16th December
Review meetings with SIDFA and ITDC

17th December
Travel to Vienna

12th December to 20th December
De-briefing meetings at UNIDO Headquarters

21st December
Return to England.
Procedure of Visits

1. Visits were planned on practical training and consultancy at factory level through a planned series of visits. The visits were all well received and the management of the foundries visited expressed their thanks and appreciation for the value of the training and practical assistance provided.

1. A total of 26 foundries was visited.

<table>
<thead>
<tr>
<th>District</th>
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<th>Private Sector</th>
<th>Small Scale</th>
<th>Total</th>
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<td>5</td>
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<td>2</td>
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<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Ankara</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>20</td>
<td>3</td>
<td>26</td>
</tr>
</tbody>
</table>

Summary Notes on the individual foundries visited are included as Appendix III.

1. The course of the visits was varied to suit the requirements of individual foundries.

Usually there was an initial meeting at which the objectives of the ITDC programme were explained, and a general description of the foundry and its products and problem was provided.

Most of the time would then be spent on the shop floor, in company with technical personnel, viewing casting defects, studying the production processes, and making - and whenever possible demonstrating - suggestions for improvements in order to overcome specific defect problems.

There would then be a final review meeting at which the recommendations could be summarised and explained to senior management.

On several occasions the foundries organised more or less formal meetings with larger groups of technical staff. Such meetings provided the opportunity for more general training as well as for question and answer sessions and detailed technical discussions.

The foundry would be invited to send participants to the regional seminar and to nominate subjects of particular interest for discussion at the seminar.

1. During some of the visits subjects and questions on foundry technology were raised which were outside the official subject of "Narrow Casting Defects". The policy was adopted of giving advice and assistance, so far as was possible, on all topics raised, although concentrating primarily on those aspects relevant to casting quality and casting defects.

1. Several of the foundries visited had been visited previously during the course of one or other of three previous training programmes undertaken for ITDC:

- U.C. Iron Production 1980
- Cupola Design & Operation 1982
- Foundry Operation 1983

Some of these foundries had made little progress in overcoming the problems previously identified. On the other hand many were taking positive steps to improve their application of technology, and improve casting quality and casting defects.

As part of the training exercise each foundry was asked to indicate one or more of the particular defects of casting origin which it would like to have eliminated and each foundry was encouraged to develop closer working relationships with suppliers of technical assistance.
Training

The set of notes prepared before travelling to Turkey covers the field of various casting defects, with special emphasis on some defects and problems observed during earlier programmes in Turkey.

The notes consist of the following sections:

- Introduction
- Problems of Defect Identification and of Nomenclature
- Organization of Inspection and Defect Analysis systems
- Notes on individual defects, covering:
  - appearane
  - possibilities of confusion with similar defects
  - causes for the defects
  - cures and methods of prevention
- Dependant on the practical steps to be taken to overcome the problem.

Appendices deal with:

- an elementary identification key
- process controls required to prevent defects
- inspection and non-destructive testing techniques
- illustrations of major defect types.

A copy of the notes is attached as a separate Appendix to this Report.

4.2.2 Although it was originally hoped that the notes could be translated into Turkish for use at the seminars, the time schedule adopted made it possible to include only the Turkish names for the defects.

The notes have been written in a brief form to assist translation, and it is suggested that ITDC should take an early opportunity to translate and issue the main section, if not necessarily all the appendices.

In addition to their use for the seminars, and for possible future seminars on this or related topics that ITDC may plan in the future, the notes are designed to be used as a practical shop floor reference guide.

The coverage of the notes, and their relevance to Turkish conditions, will make them more valuable than any of the published material on this subject, in English or in Turkish.

At the time of translation ITDC would be able to include additional photographs of defects; several of the foundries visited offered to provide examples for this purpose.

4.2.3 The notes, together with the slides prepared for the purpose, and a film on metal casting prepared by the Institute of British Foundrymen, were used to present the training seminars at different regional centres.

The emphasis in each seminar was varied in accordance with the problems found to be of particular importance to the participants during the course of the year's period of visits in each region.

In each case an informal presentation was used, and the maximum encouragement given to questions and comments from the participants. Despite the problems caused by the set to translate, some of those attending, a lively discussion was generated on all occasions.

Those attending included senior managers, technical staff, and also in some cases foremen and welders. All appeared to benefit from the experience and to have obtained the training and opportunity for the improvement of their work practices. A remarkable feature of the ITDC training was the close association of the training, technical visits, and regular reports from visiting ITDC members to the companies.
The following Seminar presentations were made:

4.4.1 Izmir, November 16th, at Pinar Döküm offices.
There were 11 participants, from 4 foundries, including Pinar Döküm.
In response to local problems and priorities, the largest part of
the time was devoted to dealing with Slag Inclusion and Blow Hole
defects in considerable detail.

Thanks should be expressed to the Management of Pinar Döküm for
providing the facility of the use of their meeting room.

4.4.2 At İskıtaş Foundry, Orhangazi, November 22nd.
This presentation was made for the staff of İskıtaş without participation
from other foundries.
There were approximately 10 participants.
The presentation concentrated on dealing with problems raised by
the participants, including the organisation of scrap reporting
and inspection systems, and problems of Blow Hole and Core Damage
defects.

4.4.3 Eskişehir, November 28th and 29th, at the Offices of the Chamber of
Industry. The Chamber has two excellent meeting rooms, and is
very suitable for the presentation of such seminars.
Thanks should be expressed to the General Secretary of the Chamber
for providing the premises, issuing invitations, and providing
hospitality.
There were approximately 10 participants, from two foundries and - for some periods
only - from the Ministry of Industry and the Chamber of Industries.
A representative from a local moulding box manufacturing company
attended one session.
The seminar covered the problems identified during the visits, and
requested by the participants. Particular emphasis was given to a
discussion of surface finish and surface defects, and to blow-holes
and sand and slag inclusions. The seminar ended with a discussion on
the organisation of Quality Control and Inspection.

4.4.4 İstanbul, December 9th, at the offices of the Istanbul Chamber of
Trade, Eminönü, Istanbul. The Chamber of Commerce facilities
were very suitable for the small group seminar; a large conference room
is also available for larger audiences.
There were eight participants from six foundries in the region, two
of which were not included in the list of foundries visited.
According to the requests of the participants, the seminar dealt with the
problems of slag inclusions, blow-holes originating from cores, lost wax, cracking, and swelling. A brief review was made of some major
points arising in connection with other defects experienced by
some of the foundries represented. The discussion was lively and
interesting, with good participation from all of those attending.

Copies of the training notes were issued to the participants, and also
to several of the engineers in the foundries visited who were unable to
attend the seminar. Attendance at the seminar may be affected by
the large number of seminars of interest to engineers which were scheduled
for the month of December in İstanbul.
4.2.4.5. Ankara, December 14th, at SEGEM training rooms.

There were 8 participants from four foundries and from the Middle East Technical University.

Subjects discussed were selected by participants, including sand and slag inclusions, Carbon flotation, gas blowholes and cracking. As on previous occasions there was a constructive discussion.

4.3. Invitations to the seminars were given verbally and informally, sometimes with only one or two days notice. If there had been time to send formal written invitations, attendance might have been greater.

4.4. The names of the seminar participants are included as Appendix IV (Page 42).
1. The training programme was successful and valuable to the Turkish foundry industry, those attending the seminars, and the companies visited.

2. The programme adopted, emphasising practical training by a series of factory visits, followed by short seminars in regional centres, proved to be very suitable and satisfactory for the topic. Many of the managers visited commented on the advantages, making it possible for staff to participate who could not be spared to attend a longer seminar.

3. Nevertheless it should not be concluded that this approach would be suitable for every topic. Less practical and more theoretical subjects would require a larger proportion of formal training sessions.

4. There is a wide variation in the standards of casting quality within the Turkish foundry industry. The best are fully comparable to international standards, whilst others are satisfied with standards which are well below those attainable. The industry is growing rapidly, in technology and in capacity, and it is likely that the least efficient will be unable to survive developing national and international competition.

Problems inherent in the quality of Turkish raw material supplies can be overcome by proper attention to technical control.

The level of knowledge and ability of individual metallurgists and foundry technologists is as variable as the quality of the castings. In many cases technical responsibility is in the hands of engineers who have no suitable background training or experience. Many others have a reasonable theoretical appreciation of the principles, but insufficient experience in the practical application of control procedures and techniques. Such management cannot give the necessary guidance to supervisors and technicians who themselves lack a satisfactory background. On the other hand some foundries maintain a staff of experienced and able foundry technologists.

It is clear that the activities of the I.T.D.C. in programmes such as these serve a continuing and valuable purpose.

5.1. A number of weaknesses and problems responsible for casting defects were common to many of the foundries visited. These included in particular:

5.5.1 Insufficient knowledge of core making methods, and of the details of the design and use of cores in castings.

5.5.2 Insufficient appreciation of the principles and importance of proper running and gating systems in preventing defects such as inclusions in castings.

5.5.3 Insufficient attention to moulding methods, and to practical shop-floor sand control, resulting in unnecessary defects due to poor mould quality.

5.5.4 Insufficient use being made of casting inspection data in guiding process control to the prevention of defects, and insufficient realization of the importance of organizing production in such a way as to obtain reliable and comprehensive inspection data as soon as possible after production.

6. The success of the programme must be attributed in large part to the constructive reception and assistance provided by the management of the foundries visited, the facilities and help given by local organizations such as Chambers of Industry, and especially to the organization and hard work of Mr. mission co-ordinator Cristalin I. Stabu with colleagues from the I.T.D.C. and the Foundry department.
6. PROPOSAL:

6.1 ITDC should arrange for the translation of the notes into Turkish, for issue to the ordinary participants, for use in future seminars, and for use as a practical handbook in foundries.

If possible more illustrations should be included, by adding photographs of defective castings loaned by Turkish foundries.

ITDC should take the opportunity of attempting to standardise the Turkish nomenclature for casting defects and technical terms. At present different foundries use a confusing variety of terminology.

6.2 The training programme should be repeated at regular intervals, preferably with the same emphasis on shop floor practical assistance from experienced foundrymen.

6.3 Consideration should be given to the preparation of simplified versions of the programme. Such versions would be designed to be suitable for:

- Groups of foremen, technicians, patternmakers and senior skilled operators without formal technical training.

- Representatives from small-scale industries, who are in need of assistance in product quality improvement, but lack resources of equipment and technical training.

6.4 For other programmes with a similar practical emphasis a similar organisation should be adopted, with short seminars in regional centres preceded by a series of factory visits for practical training.

6.5 Whenever possible time should be allowed for the translation of seminar training material into Turkish before the start of the programme.

6.6 ITDC should continue the series of training programmes provided for the foundry industry, to reinforce and continue the valuable work already done.

In particular there appears to be a need for training programmes in the following subjects, which should be included in ITDC planning for the future:

6.6.1 Practical Coremaking, including an explanation of alternative processes and practical aspects of the design and use of cores in different types of casting.

A suggested programme outline is included as Appendix V. Shortcomings in coremaking were responsible for a high proportion of the quality problems observed during the foundry visits.

6.6.2 The design of running, gating, and feeding systems for cast iron castings (gray iron, Spheroidal Graphite iron, malleable and alloy iron). Such a programme would complement the existing ITDC programme on the gating and feeding of steel castings, which has been repeated.

A programme on this subject appears to be necessary, and was specifically requested during the foundry visits.

6.6.3 Moulding Technology, to include practical training in the control of moulding sand and sand systems to suit different requirements, and in relation to the problems caused by Turkish sand and clay characteristics. The programme would also include practical instruction on the use of moulding machines in order to improve mould quality and production efficiency.

6.6.4 Maintenance of Foundry plant and equipment.

6.6.5 Management systems for foundries, in particular casting systems and a Quality Reporting and Control system.
4.7 In addition to new programmes on the above topics, consideration should be
given to repeating programmes or aspects of programmes previously presented
by IIMC. For example numerous questions were raised about details of the
production and control of S.G.Iron, and about the design and control of
ovails, both of which were dealt with in previous programmes.

IIMC has a policy of repeating valuable and useful programmes, and consideration
should be given to adding those subjects to those regularly presented.
JOB DESCRIPTION

DP/TUR/77/02/11-03/83/31.5 A

Position: Report on Ferrous Casting Defects

Duration: 2 months

Date required: As soon as possible

City station: ITDC in Ankara, Istanbul, Bursa, Izmir with possible travel within the country

Purpose of project: To upgrade the skills and capabilities of engineers employed in foundries and to train them on the subject of ferrous casting defects thus minimize rejects, increase quality and productivity.

Duties: The Expert with his counterpart(s) from ITDC will conduct a training programme to improve the casting defects knowledge of engineers employed in foundries and give necessary information about the casting defects encountered in foundries. More specifically, the Expert will be expected to:

1. Review the prevailing working methods of foundries related to identification, verification, prevention and cure of ferrous casting defects. This study will be based on the plant visits within the country. Meanwhile trouble-shooting sessions will be conducted.

2. Prepare a training programme to cover general aspects of ferrous casting defects, namely:

- Identification of defects
- Description of defects
- Causes of defects
- Prevention of defects
- Cure of defects
- Equipments for detecting the defects
3. The programme schedule might be detailed as follows:

**Preparation of seminar notes in English, in England**
- 2 weeks

**Allow 1 week for postage, 3 weeks for translation and copying, and preparing photographs.**
- **Action by SECEM not involving expert.**
- 4 weeks

**1 week travel, briefing, final arrangements, checking notes, etc.**
- 1 week

**1/2 week visits (1 week in each of four regions, e.g., Ankara, Istanbul, Porsa, Izmir)**
- 4 weeks

**1 week final report, debriefing, travel**
- 1 week

**Total**
- 8 weeks

4. The expert should supply back up materials for the mission in the form of:
- articles and lecture notes,
- films, slides and books, which may be purchased by ITDC, if the expert can make these available.

5. Supply the ITDC with necessary training aids; such as books, written articles, films, lecture notes, diagrams, etc.

6. Document the training materials in booklet form.
   The expert will also be expected to prepare a final report, sending out the findings of his mission and his recommendations to the Government on further action which might be taken.

**Qualification:** Expert, preferably a foundry engineer should have extensive experience on the subject and also training experience.

**Language:** English

**Background Information:** It has been observed that in many Turkish foundries, the quality consciousness should be improved. Reject rates in most of the foundries are very high and are above the common level in industrialized countries. The foundries suffer from a relatively high reject rate. The only reduction of the reject rate, that means a better control of the production, could reduce substantially production and operating costs.

The importance of the subject has been emphasized by also the experts which have worked for the Industrial Development Bank of Turkey. They recommended that programmes have to be developed to find out the ultimate reasons for high reject rates.
It has been suggested that an ITDC training course could help to meet this training need. This programme is organized after the requests from public and many private sector foundries and it is expected that about 30 engineers will participate.

The Industrial Training and Development Centre (ITDC) is a joint project of Turkish Government and United Nations which provides training and consultancy services to the industrial sector. Its objectives is to upgrade the skills and capabilities of professionals employed in industry thereby contributing to the national economy.
### ANNEX II

#### PERSONNEL STRUCTURE

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<th>Organization</th>
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<th>Position</th>
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<tr>
<td>UTX Vienna</td>
<td>Mr. J.P. Dee</td>
<td>Substantive Officer</td>
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<td>Mr. Yılmaz Ayman</td>
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<td>Mr. Teoman Tuner</td>
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<td>Mr. Murat Hursa</td>
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<td>Mr. Turker Aykal</td>
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<td>Ministry of Industry, Eskişehir</td>
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A well established family business, producing SG iron castings for the automotive and tractor industries. The plant is not modern, but well designed and the application of SG iron technology is good - especially the production of sound castings with a minimum of risers. Many of the castings are machined before sale.

A new extension has been approved, and equipment is being delivered. This will consist of a modern automatic high pressure moulding machine, high efficiency automatically controlled sand plant, and induction melting and short coil holding furnaces - all from West Germany. It is planned to use this facility for grey iron automotive casting production, which will place them in the second or third position in Turkey in this market from 1985.

One problem is likely to be technical management - at present the Production Director appeared to have little assistance, and it is not possible for the present high standards to be maintained in the existing and the new plant unless he is able to delegate to competent staff.

**Casting Defects Discussed:**
- Sand Inclusions
- Scabbing
- Surface Roughness

Other topics discussed:
- Operation of the new plant
- Control of sand properties, the selection of sand testing equipment, and the characteristics of the high intensity mixers ordered with the new plant.
- The use and significance of the shatter test
- Selection of coremaking processes - this aspect of the extension has yet to receive full attention, and may be affected by the limitations of local materials and technology.
In Bakişgir, as in other Turkish industrial areas, there is a large number of very small foundries and foundry workshops, employing from two to thirty people, using rudimentary technology and equipment to produce simple castings for stone parts and miscellaneous machinery spares.

The Ministry of Industry is anxious to assist these companies to develop, and a visit was arranged, through the Secretary of the Local Foundry Association, to two or three typical small foundries in a workshop area of Bakişgir.

Snap flask moulding on the floor is the principal method of production, the complete floor area - and even out onto the street - being covered with moulds before melting is commenced. The sand used is from Cerkos, which has a better grain shape and mouldability than the Sile sand used by larger foundries; however it is not sufficiently refractory for other than thin section castings. Sand preparation is by hand, or in simple home made mixers; sand screening is not sufficiently conscientious.

Cores are generally not used. Runner systems are crude, but efficient in the sense of maximising casting yield even though slag inclusion defects are frequent. Simple small cupola furnaces are used, melting pig iron and scrap with gas works coke. Casting cleaning is by wire brush.

The surface quality produced was adequate for the application, as stoves with obvious casting defects are acceptable in the market. Considerable craft skill and ingenuity is used to make the most economical use of raw materials. Many quality improvements could be made, but often these would increase nett production cost at no benefit to the product marketability - the incentive to improve will arise as competition forces rationalisation and technically better products provide competition in the market.

Working conditions were not good, and this method of production will not survive a significant improvement in the expectations and standard of living of the country.

**Casting Defects discussed:**

- Slivers, due to poor melting practice and coke quality
- Sand inclusions, due to careless moulding and poor sand preparation
- Slag inclusions, due to cold metal and crude runner systems
- Breakage, due to poor casting design and lack of metallurgical control

**Other Topics discussed:**

- Improved cupola operating procedures
- Lethargic effects of lead additions
- Design of runner systems
- Use of scrap metal as well as pig iron in charges
- Economic and practical use of moulding machines for this type of production.
The foundry is part of the Izmir works of BLC, producing British Leyland commercial vehicles for the Turkish market. Engine blocks, cylinder heads, brake drums and other grey and SG iron castings are produced.

The layout and methods are based on British Leyland experience in England; some of the problems result from the differences in materials and conditions in Turkey. This is especially true in the core-making department.

Casting Defects discussed:
Blowholes (core venting problems), finning, and penetration on water cooled automobile cylinder head castings.
Roughness (external surfaces of brake drums), Crushing and moulding defects.

Other topics discussed:
S.G. Iron treatment methods, and the possible elimination of double metal handling and transfer with resultant savings in metal temperature, energy costs, and production potential - since production is limited by melting capacity and electricity rationing.

S.G. Iron quality control and metallographic inspection. Metallography techniques need to be improved to permit a sufficient number of examinations per day.

Casting design problems, including service failures experienced in cylinder head castings used in engines which are often abused by overloading.

Sand preparation problems, associated with the characteristics of Turkish sands and bentonite.

Coreblowing methods for automotive castings.

Pattern plate design and moulding machine operation to improve mould compaction.
A small steel foundry, producing about 3 - 4 tons per day, with a work force of 115. Hand and machine moulding are used, with little mechanisation and consequent heavy use of labour. Coremaking is limited to oil sand, not well controlled, and a little furane. Induction furnaces are controlled by a simple laboratory. The lay-out of the finishing section is logical, and better than that in most Turkish steel foundries.

The plant manager is newly appointed, with no previous foundry experience, and there are no qualified technical engineers, other than an electrical engineer who was supervising the furnaces. In consequence all technical matters are inevitably left to foremen and operators; there is a serious lack of applied technology and experience, and it was necessary to give background explanations for many elementary points.

**Casting Defects Discussed:**

- Surface roughness, linked to poor sand control (there is no sand laboratory)
- Slag inclusions, linked to runner systems made by hand with no technical control
- Shrinkage defects, and problems due to wrongly applied internal chills
- Run-out and sand inclusions
- Core defects

**Other Topic Discussed:**

- Poor calculation of feeder systems
- Inconvenience of attempting to produce grey iron and steel castings in the same foundry
- Need to improve productivity by better organisation and simple mechanical aids.
- Need to standardise on methods and eliminate unsupervised hand-cut runners
- Advantages of better control of coremaking, and explanation of the CO2 process.
- Organisation of inspection and reporting systems suitable for small foundries
- Need to design patterns to permit better core location and venting.
A medium sized steel foundry, with a policy of developing expertise in the production of special purpose, premium quality, low alloy steels in order to avoid problems due to over capacity in the standard qualities of steel castings. A continuing programme of experiments and trials is giving useful results. The foundry is 15 years old and is not well laid out or organised. Most moulding is by hand although there is a machine section, and core assembly methods are used for cast chain (for marine applications). CO₂, Purane, and hot box cores are used.

A separate factory machines some of the castings, and also produces a range of foundry and other machinery for sale - sand mills, sand transporters, shot blast machines, coal crushers, etc., to Burgelik design.

 Casting Defects Discussed:

- Sand Inclusions - related to poor sand control and works organisation
- Hot Tears and Shrinkage cracks, related to casting design
- Clay Inclusions, related to running systems and pouring methods

Other Topics discussed:

- Corin and running methods for complex louvre castings, and railway engine castings
- Dephosphatisation, De Phosphorisation, and Argon degassing on a small scale for the production of premium quality steels for high specifications
- Heat Treatment, and the importance of uniform charge heating
A new company, privately owned and managed, producing grey iron castings for weights for elevators, tractor wheel weights, press bodies, and other grey iron castings. Capital expenditure has been minimised by the use of a number of pieces of ingenious home made equipment - cupola, sand mill, core sand mixer, sand transporter, sand aerator, etc. The cupola furnace is complete with simple air blast volume measuring equipment, as advised in many Turkish foundries but seen applied only in this case. By careful control of combustion conditions they are able to melt a charge consisting entirely of swarf packed into cans, giving a great saving over alternative raw materials, and a quality adequate for the requirement of counterweight castings. Melting loss is not more than 10%.

CASTING DEFECTS DISCUSSED:
Sand and Slag inclusions

OTHER TOPICS DISCUSSED:
Alternatives available for coremaking processes
Future development plans
Use of double tuyere systems for coke savings
The operation of sand coating and skin drying instead of coal dust additions.
Pikser, M. A., Istanbul Yolu 12 km., Ankara

Privy Resident  Foundry Manager

A steel foundry, producing up to 5000 tons per year, with a workforce of 150; in operation includes carbon steel, nodular alloy steel, and manganese steel castings, from very small sizes up to about 1 ton in weight. Castings are supplied to the construction-equipment machinery market and general engineering markets, mostly in the Ankara region.

The foundry dates from 1958, and there has been little investment in foundry plant since then. The facilities are therefore not modern, and not in good repair. However there has been investment in machine tools, and in an induction hardening machine, so that a large part of the production, especially of gears and shafts, is supplied in the fully machined and heat treated condition.

There is insufficient quality control equipment, and too high a proportion of the work is made by hand. Coremaking is by the furane process exclusively. Nevertheless castings are made to high standards, with radiographic soundness criteria having to be met on several pieces.

Castings Defects Discussed:

1. Hot Cracking, including cracking of manganese steel after cutting off feeders.
2. Shrinkage
3. Gas Inclusions
4. Blow holes near feeder connections

Other topics discussed:

1. Use of chromite sand to accelerate cooling
2. Feeding and running system for sinter palette castings and for roll bearings
3. Use of Furma moulding instead of hand moulding
4. Use of engineering air quenching of hypereutectic furnace charges.
Doktas A.S.
Ozanangazi, Near Bursa

2nd November 1982

Yalali Gunay
Technical Director

Ilhan Bataci
Production Manager

Levent Hatirli
Projects Manager

A modern mechanised iron foundry, reputedly the best equipped and most technological advanced Turkish foundry. 19,000 tons of castings per year are produced for the automotive and tractor industries – Doktas is part of the Koc group which produces Ford and Fiat vehicles. Castings are exported to western Europe. Quality is good, and the staff are technically competent and well-informed.

Nevertheless productivity and plant utilisation, and also casting scrap, are below European standards. A new moulding line is being installed during 1984.

Casting defects are a serious problem; records and data are comprehensive, showing a gradual improvement year by year ( currently 11% total scrap ). Many of the quality and production problems arise in the coremaking area.

Full use was made of the visit; a group discussion on individually difficult casting defects was arranged with senior technical managers in the morning. This was followed by a plant visit, and a presentation of some general principles to a wider management group in the afternoon. The visit concluded with a discussion of optimum methods of organising casting inspection – improvements could be made by obtaining, and using, inspection data more promptly.

Casting Defects Discussed:

Gas Blowlakes ( Core production, venting, and print scaling )
Crushing and mould damage, often due to core distortion
Pockets and short pouring, due to poor pouring control
Sand inclusions: due to drying out of part completed moulds during plant stoppages.

Other Topics discussed:

Operation of mechanised pouring systems, pouring bushes and operator visibility.
Methods of maximising mould compaction with multi squeeze head machines
Core sand composition, and iron oxide additions
Core coating and drying, and thermal behaviour of cores
Core deterioration in storage
Production of complex cylinder head castings

Effects of Phosphorus and Sulphur on metal penetration and inoculation response
A family owned company, producing cast iron and cast iron components for the Turkish market - now investigating the export potential. The plant is not new, and although reasonably efficient is in need of some modernisation to compete internationally. Management is investigating various processes, such as the Vacuum process, but investment costs are limited, and must be phased to secure acceptable cash flow.

Casting Defects Discussed:

Cracking
Squint and other sand defects
Insufficient seating and sand through poor supervision of pouring and melting
Gas Holes and Cold Shot, due to lack of sand control and of pouring temperature control.

Over-Tuning Discussed:

Advantages and problems of the Vacuum moulding process
Improved design systems for cupola furnace thermal efficiency
Need to operate consistent sand control
More care in handling to avoid damage to fragile castings
Possible design changes to minimise the likelihood of defects.
A small foundry, employing 30 people and producing about 70 tons of non-alloy cast steel, had been purchased, and additional moulding machines were to be installed. The core-making, and especially the cleaning and dressing treatments were also in need of improvement.

Quality was good, and rejection rates generally low, thanks to close control of a limited range of production, by experienced management.

Defects discussed:

- Inclusions and sand inclusions
- Slag and surface defects
- Core-printing

Other topics discussed:

- Optimization of the use of the new induction furnace
- Improved efficiency by alterations to the methods of magnesium treatment
- Correct operation of the moulding machines, especially squeeze head size.
one of the first modern foundries in Turkey, closed following labour problems in 1979, and reopened in 1982 with new management and under new ownership. There are two separate foundries, for iron and steel castings. Production is very varied:

- 5000 - 7000 tons, yr of 12y & 28, Chrome steel grinding balls, for the Turkish and Iraqi market
- 2000 tons, yr of General medium and heavy steel castings
- 3000 - 5000 tons, yr of Cast iron, including cylinder blocks and heads, gearboxes, and SG iron insulator cap bodies and tractor castings.

Because of this variation, and the limited experience of the new management, there are many technical problems and scrap is high. The plant and equipment is not fully utilised.

**Casting Defects Discussed:**

- Surface roughness (Poor sand control)
- Irregular break-off fracture (Poor pattern maintenance and poor moulding)
- Cracking on grinding balls (Heat treatment and grinding problems)
- Blow holes in cylinder heads (Core making and venting practice)
- Breakage of narrow castings during customer processing

**Other Topics Discussed:**

- Organisation of Inspection systems
- Running and gating of cylinder heads
- Contraction allowance and feeding methods for large Manganese steel cover castings
- Casting production techniques for heavy SG Iron wheel castings
- Moulding machine operation for maximum sand compaction
- Metal pouring temperature measurement and control
- Core sand specifications and resin contents
- Problems with delayed setting time of furnace sand in cold weather
- Core venting techniques for hot box coremaking
- Choice of major coremaking processes - SO₂ or Amine

**Pattern Design problems**

- Comparison of productivity, energy consumption, and quality standards between Western European and Turkish foundries
- Investment priorities.

At Plant management request a second visit was arranged, for a round-table discussion and question and answer session on a number of specific technical points and general criticisms. This meeting was attended by about 12 to 15 metallurgists, technologists, and managers.
The foundry produces about 1000 tons of grey iron, 450 tons of steel, and a little non-ferrous metal, annually. However, the plant has substantially greater capacity than this; productivity was low and scrap was estimated to be about 20%. There is a mechanised moulding plant, a large hand moulding area, cupolas, induction furnaces, a good pattern shop, and a core making area (oil sand and furan). Technical control is not good, especially in the core making area. Most steel castings are weld repaired.

Casting Defects Discussed:
Hot cracking and tearing of steel castings - shrinkage defects
Blow holes, attributed to poor control of core curing and venting
Rough castings undercrushed moulds, mostly due to poor sand preparation and inadequate control of moulding techniques.
Burnt on sand, due to variations of methods of mould coating.

Other Topics discussed:

- Inventor of the CO2 core making process
- Means of ventilation and sealing of core pins
- Need for temperature control in the core stove
- Feeding technique for steel wheel castings - importance of feeding distance as well as of relative modulus.

- Model castings for bronze castings
- Good melting efficiency and time cycle
- Need to consider important casting faces when planning methods.
Ditil S.A.

Zeytinglu
Salim Vatandemir
Yakup
Mehmet Erturk

Director
Foundry Manager
Works Engineer
Metallurgist

Ditil produces about 500 tons per month of grey iron castings in various categories: ingot moulds, metal rolls, die blocks and other heavy castings, and machine moulded castings such as flywheels, wheel weights and general engineering pieces.

Sypok melting is used, despite the variety of metal specifications required. There are two machine moulding lines, and a hand moulding section. Cores are blown, or hand made, in CO2, coated with silica flour wash.

At the present time surface roughness and adherent sand problems are a major difficulty for the company as shotblasting is a bottleneck and casting sales are being restricted.

Casting Defects discussed:
Surface roughness and adherent sand
Scale and Ridges
Chipping
Hot tearing in ingot moulds

Other topics discussed:
Corebox construction for flywheel-fan castings
Improved sand testing methods and records
Design of the Shatter Test apparatus
Need to measure and control volatile material content in moulding sand
Mould connection on deep machine moulded castings
Estimation of new sand addition requirements
Shotblasting machine efficiency
Marketing and development policy
Metal pouring temperature control in relation to casting section
The firm is a well-established private sector foundry, supplying the tractor and municipal vehicle markets. Most of the castings are supplied fully machined. The machine shop of the production is in Mr. Iron.

In addition to the conventional system, which is soon to be augmented by two new automatic high pressure moulding lines (of German and Danish manufacture) which are now nearing the final stage of installation.

The process includes a variety of processes and equipment, including a new vertical section for the production of amine-cold box cores — believed to be the first application of this process in Turkey. The output from this section is still experimental, and numerous sand and coreblowing problems, as well as feeding condition problems, remain to be overcome.

**Tentative Subjects Discussed:**

- Rims in Tractor Front Support castings
- Parts in brake arms
- Molding in brake lines
- Skirvines / connecting rods

**Other Topics Discussed:**

- Coreblowing techniques for amine process
- Design of corebox vents
- Methods of sand cooling
- Importance of pattern heating
- Importance of cooling towers, etc. control
- Induction practice for iron
- Blast and design and low elongation figures in territic 35 iron
A steel foundry producing mainly wheel hubs for commercial vehicles.
Most of the moulding is by hand, although three moulding machines have
been installed. Coremaking is with greensand /dextin, by hand, or
for some special cores in furane. Neither moulds nor cores were painted.

There was little technical control - no measurement of pouring temperature,
simple runner systems cut by hand without supervision, etc. There is no
laboratory, although the equipment for this is said to be on order.

Most castings contain defects, and are weld repaired.

Casting Defects discussed:
Cold cracking and brittleness. It was not possible to see an example of this
problem which was stated to be a serious, although not consistent, defect.
Advice was given to pay more attention to basic technical control before
incurring expenditure on investigations into unusual metallurgical phenomena.

Sand and Slag Inclusions

Other Topics Discussed:
Use of alternative core making processes
Training of workers and supervisors
Metal degassing, killing, and pouring temperature control
Raw material inspection and selection
Future development plans.
The company, belonging to the glass making subsidiary of Igus, produces glass bottle moulds for the parent company, and also grey iron and grey iron castings for the tractor and agricultural vehicle industries. Product quality is high, but internal reflections at about 3% - 4% represent a serious problem. Production efficiency is also low, output being controlled by electricity consumption controls. Production techniques are conventional, with mechanized moulding and core-setting equipment of German origin. Some castings are exported to the United States.

Quality defects discussed:
- Poor release from cores
- Burnt-on core surfaces, resin sand
- Sand inclusions
- Cracks in core-sand moulds
- Shell and hardness in grey iron castings
- Weekness in SG iron
- Core grain porosity in chill-cast bottle moulds

Ideas discussed:
- Use of process heating for duplexing to increase output from limited power supply.
- Better system related to raw material selection and metallurgical control in SG.
- Heat treatment of grey iron castings
- Productivity statistics
- Core storage

Core box and pattern design, especially design of tolerances and details of organization of Quality Control and Inspection.
Iron- and steel-foundry, specialising in castings for the cement
and concrete, and mining industries, including a variety of wear and abrasion
resistant alloys. Cement mill cylinders are chill cast from copper-melted iron,
while rotors, hammers, plates, liners, etc. are sand cast and chill cast from
electric-melted alloy steels.

Despite the metallurgical complexity of the products and processes, the foundry
analysed its metallurgists. The technical managers are chemical engineering
graduates.

Work organisation and technical control should be improved; however the
product quality is adequate for the applications in the Turkish and Iranian
markets at present.

Castings Defects Discussed:

- Metallurgical specification problems
- Heat treatment scaling and distortion
- Other topics discussed:

Composition and production techniques for Ni-based castings
- Cure operation improvements

Necessary process and material changes if thin section stove plate castings
are to be produced, as part of a planned diversification programme.
The foundry is situated near to the centre of the city and is attached to the works producing railway and off highway vehicles.

The foundries are not modern, although two sets of moulding machines have been installed. Much of the production is manual, including castings.

The foundry moulds butter plates and trumpets for use in SKL steel casting works.

Surface defects, various causes
Blemish inclusions
Definements

Other topics discussed:
- Efficient utilisation of moulding machines
- Selection of core-making processes
- Improvement of technical control
Orsan produces centrifugally cast cylinder liners for the Turkish and export markets. Close metallurgical (chemical and metallographic) control is applied in the foundry, and precision machining and inspection techniques in the finishing departments.

In addition to the centrifugal foundry, a small sand moulding section produces pistons for refrigerator compressors, and hydraulic control valve bodies.

**Casting Defects discussed:**

Core blowing defects on sand castings

Graphite morphology and metallurgical defects in centrifugally cast cylinder liners, including the effects of nitrogen from synthetic recarburisers.

Shrinkage and inclusions in centrifugal castings.

**Other topics discussed:**

Mould materials to maximise centrifugal casting mould life. A series of tests is to be carried out by TUBITAK (Marmara Institute) and suggestions were given into the material compositions for evaluation, including the use of vermicular graphite iron.

Mould life is the critical economic factor at Orsan, controlling mould costs and casting yields.

Coremaking. At present sand moulding is an insignificant part of Orsan output but they plan to develop hotbox coremaking for finned air-cooled cylinders. Present technology is not well applied, and suggestions for improvements were presented.
A steel foundry specialising in wheel hubs and other commercial vehicle castings. Furane moulding is used, together with sand reclamation. There is also a greensand moulding area, and plans for the future installation of mechanised greensand production. Core-making is not mechanised, and less well controlled than the moulding.

Development work is being undertaken into the application of computer programming for metallurgical purposes, such as optimum charge calculations.

A routine Management Technical meeting was attended, and specific defect problems were introduced and discussed. Further detailed discussion took place on the foundry floor.

Pinar DMK'U management provided the use of a meeting room for a more formal seminar training period on November 18th, attended by Pinar DMK'U technical staff, as well as by participants from other foundries in Izmir.

Casting Defects Discussed:
- Hot tearing and shrinkage in low carbon steel hub castings
- Blow holes in steel support arm castings
- Metal Penetration

Other topics discussed:
- Possibility of making exothermic or insulating sleeves from available materials
- Design of runner systems for slag removal in steel castings
- Problems caused by variation in properties of furane resins
- Use of internal chills
- Methods of venting cores for furane sand production.
- Use of reclaimed sand with reduced binder content to improve breakdown of cores.
- Applications of computer systems for casting weight and feeder calculation.
A grey iron and SG iron foundry with a well-planned mechanised moulding unit, as well as a hand moulding section and a small centrifugal casting department. Hot-box, oil sand, and greensand cores are used.

Productivity and machine utilisation are not good, reject rates are high and the casting quality is below the potential of the equipment. Nevertheless the sales policy is to attract difficult work, such as complex diesel engine cylinder heads, which are beyond the skills and experience of the staff.

They were anxious for "text-book" metallurgical information, but lacked experience in practical foundry production, organisation and quality control.

Casting Defects Discussed:

- Blowholes, related to core venting, especially on cylinder heads
- Slit inclusions, related to poor runner system design
- Surface sinking of SG iron castings
- Cross Joint

Other topics discussed:

- Design of runner and feeder systems for grey and S.G.Irons. The question was raised as to whether SEEM could mount a seminar in the future on this topic.
- Metal handling systems to avoid multiple ladle transfers and consequent loss of temperature resulting in casting defects, and also in reduced production capacity.
- The production of riserless castings in SG iron.
- The composition of SG iron to achieve individual casting specifications.
- Sources of information on International Specifications.
- Sand properties and moulding machine operation to ensure the production of rigid moulds, without which it will not be possible to reduce the use of risers.
- Methods of venting and sealing cores to reduce blowhole incidence.
- Support systems for flaskless moulds.
- The "trigger" process of delayed SG iron treatment.
- Methods of desulphurisation with Calcium Carbide.
The foundry is part of the Turkish Sugar Company machine production works, producing equipment for sugar refineries and other state enterprises (cement works, railways, etc) in Turkey. Separate sections produce cast iron, steel, and bronze melted in cupola, induction furnace, indirect arc furnace or fuel oil - crucible furnaces. Most of the moulding and core-making is manual, although there is a small machine moulding section. A few cores are made in furane, but most are made in greensand with a bentonite and 1% dextrin binder.

Scrap is high, in the foundry and in the adjacent machine shop, and the quality of the castings which are accepted would not be adequate for most commercial purposes. However some complex and intricate castings are produced successfully. Formal technical control is not sufficient.

Casting Defects discussed:

- hot tears and shrinkage cracks in steel castings - partly due to lack of pouring temperature control
- surface roughness and expansion scabs
- sand and slag inclusions
- internal porosity leading to leaking of heat exchanger castings, probably due to the use of insufficiently clean chaplets.
- box holes from wet sand.

Other Topics discussed:

- sand milling procedures and efficiency
- cupola blast systems
- the need to avoid lead additions to cast iron
- pump impeller core design
- runner systems and feeding systems for steel castings.
T. Trakia Fabrikası, Ankara, Turkey 3400, May 31st, 1960

Mr. Ertan, Manager
Mr. Tugrul, Metallurgical Engineer

The foundry is an integral part of the Trakia Tractor Factory, which produces 150,000 tractors under licence for the Turkish and Iranian markets. Two types of grey iron castings are produced annually in a limited range of parts - the country has inadequate capacity for all castings required, a proportion of which are purchased outside.

The facilities are well mechanized, and well utilized. Casting quality is generally satisfactory, partly due to a good liaison between the foundry and the tool shop and design staff. Scrap is held at below 5%.

A new electric melting plant has been installed and commissioned during May 1960, but has since been closed despite good technical results on account of the severe electricity rationing restrictions being imposed as a result of hydroelectric generating capacities being exceeded by increasing demand and low rainfall. An old cupola plant is having to be used.

Casting Defects Discussed:
- Gas Inclusions
- Non-metallics
- Porosity in cores
- Voids

Other topics discussed:
- Dust extraction systems for electric furnace charging
- Use of computerized scrap recording and analyzing systems
Yusuf E. & Cevat Timur A.Ş.  
Istanbul, 14th 26 Dec., Ankara  
9th December 1983

Director

Brass castings in a variety of sizes are sold in the Turkish and Middle Eastern markets. The foundry produces the castings for the customer, and also castings for outside customers, including pump factories in Iran, and electric motor producers in Turkey.

Casting is semi-mechanised, using moulding machines and a sand and covering system of their own design. Melting is by cupola.

The foundry prides itself in being a cast-making, with uncertainty over which process to adopt, and how to mechanise core-making effectively. A request was made for an HTDC programme on this subject.

Casting appearance and quality is satisfactory for the applications, although internal rejections are higher than should be possible with a limited range of options for machining on site.

Casting defects discussed:

- Porosity
- Shrink
- Hot and cold inclusions

Other points discussed:

- The choice of coremaking process
- Breakout problems with the CO₂ process
- Building box pin and bush system and maintenance
- Cast iron operation and possible means of improving efficiency
- Plans for induction furnace installation.
## APPENDIX IV

### SEMINAR PARTICIPANTS

<table>
<thead>
<tr>
<th>1. İzmir</th>
<th>Company</th>
<th>Occupation</th>
<th>Years of Experience</th>
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<tbody>
<tr>
<td>Muammer BİLGİÇ</td>
<td>ORCANER</td>
<td>(Foundry Eng.)</td>
<td>2 months</td>
</tr>
<tr>
<td>Erdoğan DOĞRU</td>
<td>PINAR</td>
<td>Met. Eng.</td>
<td>5-6</td>
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<tr>
<td>Muhsin TÜFEKÇİ</td>
<td>BMC</td>
<td>Met.Eng.</td>
<td>3.5</td>
</tr>
<tr>
<td>Nadir ÇOBAN</td>
<td>PINAR</td>
<td>Met.Eng.</td>
<td>4</td>
</tr>
<tr>
<td>Sadi ERŞAHİN</td>
<td>ŞAFAK</td>
<td>Foundry Foreman</td>
<td></td>
</tr>
<tr>
<td>Hüseyin AKINCI</td>
<td>ŞAFAK</td>
<td>Foundry Foreman</td>
<td></td>
</tr>
<tr>
<td>Ali Rıza METE</td>
<td>ŞAFAK</td>
<td>Foundry Foreman</td>
<td></td>
</tr>
<tr>
<td>Halit TANYELİ</td>
<td>ŞAFAK</td>
<td>Met.Eng.</td>
<td></td>
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<tr>
<td>Ali Galip ERYİLMAZ</td>
<td>PINAR</td>
<td>Technician</td>
<td></td>
</tr>
<tr>
<td>Yalçın ÇAY.</td>
<td>PINAR</td>
<td>Met. Eng.</td>
<td>2</td>
</tr>
<tr>
<td>Ersan KARAGÖZLÜ</td>
<td>PINAR</td>
<td>Asst.of Gen.Director</td>
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<tr>
<th>2. Eskişehir</th>
<th>Company</th>
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<tr>
<td>Haldun ERTAN</td>
<td>ENTİL</td>
<td>Met. Eng.</td>
<td>8</td>
</tr>
<tr>
<td>Mustafa ÖZER</td>
<td>ENTİL</td>
<td>Chem. Eng.</td>
<td>6</td>
</tr>
<tr>
<td>Ruhi AKSU</td>
<td>ENTİL</td>
<td>Moulding Supervisor</td>
<td>10</td>
</tr>
<tr>
<td>Salih VATANSEVER</td>
<td>ENTİL</td>
<td>Plant Manager</td>
<td></td>
</tr>
<tr>
<td>Süleyman KİZILKAYA</td>
<td>ŞEKER Fab.</td>
<td>Foundry Foreman</td>
<td>22</td>
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<tr>
<td>İsmail KIŞ</td>
<td>ŞEKER Fab.</td>
<td>Quality Control Technician</td>
<td>9</td>
</tr>
<tr>
<td>Hüseyin TUNA</td>
<td>ŞEKER Fab.</td>
<td>Foundry Foreman</td>
<td>21</td>
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<tr>
<td>H.İbrahim SIKI</td>
<td>ŞEKER Fab.</td>
<td>Pattern Shop Supervisor</td>
<td>19</td>
</tr>
<tr>
<td>3. ISTANBUL</td>
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</tr>
<tr>
<td>Mahmut GÜNEY</td>
<td>ELMET A.Ş.</td>
<td>Met. Eng.</td>
<td>4 Months</td>
</tr>
<tr>
<td>Levent DOSTOCLU</td>
<td>ELMET A.Ş.</td>
<td>Met. Eng.</td>
<td>1</td>
</tr>
<tr>
<td>Erden KARAESMEN</td>
<td>ELMET A.Ş.</td>
<td>Met. Eng.</td>
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<tr>
<td>Mustafa KIRIŞIK</td>
<td>DÖKÜMAY A.Ş.</td>
<td>Met. Eng.</td>
<td>7</td>
</tr>
<tr>
<td>Ata SEZGIN</td>
<td>DÖKYOL Dök.San.</td>
<td>Met. Eng.</td>
<td>9</td>
</tr>
<tr>
<td>Akın TULUNAY</td>
<td>SİNGER San.A.Ş.</td>
<td>Met. Eng.</td>
<td>5</td>
</tr>
<tr>
<td>Tayfun TEZANLAR</td>
<td>Ferro Dök.A.Ş.</td>
<td>Met. Eng. M.Sc.</td>
<td>2</td>
</tr>
<tr>
<td>Ömer GÜKkan</td>
<td>Norm - 82</td>
<td>Met. Eng.</td>
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<th>4. ANKARA</th>
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<th>Years of Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bekir Sitki HEPER</td>
<td>YAZAR POMPA</td>
<td>Mech. Eng.</td>
<td>10</td>
</tr>
<tr>
<td>Kerim BİLGEHAN</td>
<td>MKEK</td>
<td>Foundry Eng.</td>
<td>5</td>
</tr>
<tr>
<td>Veyis SARIĐUMAN</td>
<td>MKEK</td>
<td>Foundry Eng.</td>
<td>6</td>
</tr>
<tr>
<td>İlhan ERKUL</td>
<td>ERKUT San.A.Ş.</td>
<td>Met. Eng.</td>
<td>3</td>
</tr>
<tr>
<td>Sinan VAROL</td>
<td>ERKUNT A.Ş.</td>
<td>Met. Eng.</td>
<td>1</td>
</tr>
<tr>
<td>İlhamı PEKTAS</td>
<td>ERKUNT A.Ş.</td>
<td>Met. Eng.</td>
<td>1</td>
</tr>
<tr>
<td>Ergun ATAMAN</td>
<td>MKEK</td>
<td>Met. Eng.</td>
<td>1</td>
</tr>
<tr>
<td>Abdullah GÜNDÜZ</td>
<td>O.D.T.U.</td>
<td>Met. Eng.</td>
<td>1</td>
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</table>
In the training visits to Turkish foundries, as undertaken in the course of various I.T.Y programmes, it has become apparent that there is a severe lack of knowledge of coremaking technology, with resultant ills in the foundries.

In particular it has been observed that frequently there is:

- Lack of knowledge of the available alternative coremaking processes
- Inadequate and incorrect use of mechanical or inappropriate processes
- Inadequate appreciation of the precautions necessary to make satisfactory cores of Turkish raw materials
- Failure to apply proper coremaking process and quality controls
- Inadequate corebox and tooling
- Inadequate coremaking equipment
- Lack of productivity and uneconomic use of materials

As the Turkish foundry industry develops in response to the requirements of a developing economy and engineering industry, and as the export of castings becomes more important, the implications of these defects will become more serious.

II. OBJECT

A Turkish programme should be organized by I.T.Y., in order to improve the present level of Turkish foundry practitioners in the field of coremaking. It should cover an appreciation of the important factors to be considered in the design, production, quality control, and application of cores produced by available alternative processes, including processes already used in Turkey, and those which have not yet been adopted by the Turkish foundry. The programme should have a practical emphasis, and be arranged with a full appreciation of the special problems and conditions of the Turkish foundry.

I. CONTENTS TO COVER

- The use of cores. Functional requirements and alternatives.
- The design of cores, in relation to core production, casting quality, and economics.
- Critical tolerances and methods of location and venting.
- Coremaking practices: Sand, Shell, adhesives, including reference to the particular attributes of critical attributes of various systems.
- Stock control of coremaking processes and equipment.
- Review of alternative coremaking processes, including processes traditional in Turkey and newer processes which have been, or might in future be, adopted by Turkish foundries. Consideration of the practical and functional advantages and disadvantages of each process in the scope of suitable applications.
- Coremaking productivity, control and monitoring.
- Maintenance, in the sense of equipment and tools.
The subject should be covered in a concise set of training notes; time should be allowed to translate these into Turkish before the practical stage begins in earnest.

The programme should include visits to iron and steel foundries, producing large and small quantities of castings by manual and by mechanised processes. Existing practice will be observed, to confirm and extend the observations made during earlier visits. Practical advice and assistance will be offered at the shop floor level, and in-plant training will be provided.

The programme should also include formal seminar training sessions, probably requiring a minimum of 3 or more days in view of the range of the subject and the possible unfamiliarity of some of the likely participants with important aspects of the subject matter. It may be advantageous to repeat the seminar presentations, modified to suit local problems, in more than one regional centre. Adequate opportunity should be provided for discussion and questions.

As well as representatives from foundries, it may be found useful to arrange for more participation from pattern making companies, since it has been observed that many coremaking problems stem from corebox design and construction shortcomings.