OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org
Yugoslavia.

TECHNICAL ASSISTANCE TO THE INDUSTRY OF
ENGINE PARTS AND ALLIED COMPONENTS.

Technical report. S1/YUG/82/803

Prepared for the Government of Yugoslavia by
United Nations Industrial Development
Organization executing agency for the
United Nations Development Programme

Based on the work of J.M. Kraśnicki specialist
in foundry equipment

United Nations Industrial Development Organization
Vienna

This report has not been cleared with the United Nations Industrial Development Organisation which does not therefore necessarily share the views presented.
Table of contents

Abstract

I. General data about the factory RO
   "27 MART", Novi Sad, Yugoslavia

II. Existing state of production of cylinder liners

III. Measures and actions proposed to improve the quality of product and increase the output of small centrifugal machines

Annex 1. Technical specifications for mechanical weigh

Annex 2. Technical equipment recommended for purchase to improve the quality of centrifugal castings

Annex 3. Program of further actions which should be undertaken to improve the centrifugal casting process in the foundry


Drwg 2. The dosing by volume by means of a box with calibrated sleeve

Drwg 3. The cylinder liner pusher /re-construction/
During the short - term assignment lasting 1,6 months the work was concentrated on problems of production of cylinder liners in the foundry "I. C. Y. M. M. " in Novi Sad, Yugoslavia, specifically design of equipment.

Improvements into the operation of feeding of the centrifugal machines, into construction of these machines and organisation of work have been proposed, aiming to increase the accuracy of raw liners, reduction of personnel and increase the output.

Detailed list of technical equipment recommended to purchase is annexed and the draft program of further actions which should be undertaken to improve the centrifugal casting process in the "27 M. M. " factory.
I. GENERAL FACTS ABOUT THE FACTORY "NO 27"

NOVI SAD, YUGOSLAVIA

The factory situated at the outskirts of Novi Sad, the capital of autonomous region Vojvodina, employs about 1000 persons and its production programme covers parts and subassemblies of engines and automobiles: cylinder liners /centrifugal castings/, pistons, piston rings, piston sets, ribbed cylinders /Cromin; wogva/; indicator heads; valve seats and guides various machine parts. etc. etc.

The main plants of the factory are: the Foundry and the rolling plant.

The factory has 55 years old history, but the present objects were erected about 20 years ago, basing on the Soviet documentation on supplies.

In spite of experienced and devoted manpower relatively good technological discipline - the technical and economic results, especially of the foundry, are poor.

This situation should be attributed to old, greatly depreciated machines, generally out of date technology, lack of modern auxiliary and control equipment, poor quality of auxiliary materials furnaces of induction channel type furnaces is the sign of some improvement in this field.

The main product of the factory are cylinder liners /the present production range about 450,000 pcs finished liners p.a./ with real chances to increase the output up to 1 million pcs p.a. due to favourable situation in the market.

Therefore strong emphasis should be put in this project on problem concerning liners /design of machines and moulds, metallurgy, organization of work/ to gain maximum increase of output with minimum investment costs and without standstills in production.
In the present production programme of cylinder liners produced in the lines engines liners /MAN, Perkins/, the next year form "O" -head Otto engines liners the least numerous group connecting liners.

The long series: MAN /540,000 pcs/year/, Perkins /30,000 pcs/year/. The dimensions of a representative MAN liner: D = 330 mm, t = 310 mm; weight: 14 kg. The dimensions of a Perkins liner: D = 30 mm, L = 103 mm; weight: 5,5 kg.

The liners are manufactured of low-alloy grey iron with indicated contents of Cr. Approximate pouring temperature: 1350 °C.

The acceptance procedure in the foundry comprises: non-destructive measurements /220 - 250 H_2/ and metallographic structure tests /perlito/.

Iron for liners is melted in two 8 tons cupola furnaces with tilting receivers. It is poured from a receiver to the ladle 500 kgS hanging on a monorail and is transported to the centrifugal machines.

These machines are grouped in two stands:
- the big 12 - position carousel Soviet manufacture
- stand of fourteen small centrifugal machines CM-5 Polish manufacture. All these machines have horizontal axis of rotation and are water - cooled.

The carousel in poured directly from the ladle 500 kgS / with by weight batching device/, metal for small machines is first desulfurized / by means of soda ash/, then poured to a small tilting tank, from which it is batched by weight to small manual ladles /shanks/.

The "dry" could surface coat for iron of the commercial name "Dormati" /Yugoslavian product/ is used here.

Liners - solidified and cooled to the temperature about 700°C - are pulled out from the machine and put on the chute from which they fall onto the underground apron conveyor. At the outlets of the conveyor the first technical inspection takes place and then coatings are thermally treated /stress - relieving/, 2 hours 450 - 550°C /

The productivity of the carousel: 1200 pcs / shift with the manpower 7 persons.
The productivity of small centrifugal machines:
100 pcs / shift, with manpower 12 persons.
Metal consumption: the carousel 15 tons / shift,
the small centrifugal machines: 8,5 tons / shift.
Due to excessive machining allowances and high percent of scrap, the general yield of production of liners is very low /65%, 70%/
for small liners /

Analysis of the stand of small centrifugal machines:
In accordance with suggestions of the management of the factory, the operations /2/ machines CM-3 was analyzed more careful.
The average cycle of work of a machine lasts about 120 sec. It consists of the following operations:

- rotation, including pouring, solidification and cooling 150 sec /1/
- removing of front bottom end of the liner 20 " /2/
- cleaning of the could /with brush and compressed air/ 30 " /2/
- introducing of powdered cost 10 " /2/

The operations /1/ and /2/ last too long. The theoretical time from pouring to removal of a casting - when cooling with water - amounts 76 sec. The operation of removing of a hot liner is done manually using method of rapping, is not only time consuming, but also very tiring.
The personal of the stand is too numerous /totally 12 persons/:
1 worker is busy with transport of metal from the cupola, 1 cleans the tilting tank and the weigh, 2 pour machines, 7 operate machines, 1 is responsible for coats.
The average scrap /outfall/ amounts ab. 30% .
Causes of outfall can be divided into four groups:
- inclusions of sand on outer surface of the liner - 25%
- slag inclusions near inner surface - 30%
- wrong structure /presence of cementite/ - 25%
- not met dimensional tolerances

The extremely small area between two rows of machines and work, slippery floor create a real hazard for workers who handle there with molten metal and hot castings.
In conclusion; the stand of small centrifugal machines CM-3 requires immediate innovations and reconstruction.
MESSURERS AND ACTIONS PROPOSED TO IMPROVE THE QUALITY OF PRODUCT AND INCREASE THE OUTPUT OF SMALL CENTRIFUGAL MACHINES
(presented in drwgs.1,2,3)

The main problem, how to increase the dimensional accuracy of cylinder liners and to reduce the number of workers employed on this stand, can be best dissolved by introducing the "by weigh" dosing of iron into the machines. The only new equipment in the system will be the mechanical, dial weighing under a monorail track and carrying hoist with the ladle 200 KGS capacity. The detailed technical specifications for the weigh are listed in the Annex 1.

The batches of liquid iron previously determined and set on the weigh will be signalled by means of electric signals, i.e. the color bulbs on the perimeter of the weigh and on the ladle holder near the operator's eyes, will flash. The button to readjust "0" after each filling of the ladle should be located on ladle holder in the reach of operator's hand. The capacity of the ladle (200 KGS) is sufficient (with reserve) to pour all the machines CFM-3 working in the stand (13 pcs according to the drwg.1).

The transport system of two tracks: track "A" (existing) with a ladle 500 KGS from the cupolas to the place where filling of the ladles 200 KGS and modification of metal will take place and track "B" - in the shape of a closed loop, where two ladles 200 KGS will circulate working in continuous (cyclic) system of work. Short distances, little space, many starts and stoppages make it impractical and not economical to introduce electric drive for ladles. Therefore the conception (drwg.1) is based on "CENTROZAP" manually operated equipment, listed in the Annex 2. It is strongly recommended or to
purchase this equipment or to design the new one basing on the
"CENTROZAP" elements as a model.

To obtain more space for operation of ladles, the left row of ma-
chine (together with chutes) should be displaced at the distance
about 1300 mm to the left (facing to the carousel). To improve the
safety conditions, the whole floor inside the stand should be re-
placed.

Drwg.2 presents interim solution (e.g. during a failure of the we-
igh) ... that is "by volume" system of batching. The pouring box ha-
vying volume exactly equal to the volume of metal required to po-
ur the machine, fixed to the inlet trough, has calibrated hole made in
core-sleeve, securing outflow of metal at the average speed of 1kg/sek
In this variant much depends upon skills of the operator although the
dimensional accuracy of the castings will be worse.

After implementation of the changes proposed on the drwg.3 (introdu-
cing bronze sleeves, change of material of the pushing piston onto
very heat-resistant alloy Prokron 10) the operation of the pushing-
out mechanism will run smoothly, without obstacles and manual drag-
ing of castings.

After implementation of all the proposed changes the following advan-
tages will be obtained:

- good accuracy of the castings (the inside diameter tolerance
  in the range ±0.4 mm)
- reduced number of personnel (down to 7 persons)
- increased output due to the enforced cyclic system of work.
Annex

TECHNICAL SPECIFICATIONS FOR THE MECHANICAL WEIGHING

1. High resistance against elevated temperatures, dust, corrosive gases, and mechanical shock.

2. The range of weighing: 0-200 KG.

3. The smallest graduation: 250 G.

4. Automatic readjustment of "0" after a signal of the operator (e.g. after pressing a button by him).

5. The dial should be equipped with a set of adjustable contacts for signalisation purposes.

6. Signalisation-by electric system (own source of energy). Signals, after closing the electric circuit, should be transmitted to the ladie (protective shield on the operator's side) and outside the dial.

Note:

As the alternative to the electric system of signalization consider the pneumatic system as very reliable in hard conditions of work, in dusty atmosphere, high temperatures and the like. All component elements, including color signalizators are manufactured by many firms, i.e. MECHAN, Sweden. Thin flexible plastic tubes connecting the weighing with the signalization points are easily repairable in case of breaking or other failure.
TECHNICAL EQUIPMENT RECOMMENDED FOR PURCHASE TO IMPROVE THE QUALITY OF CENTRIFUGAL CASTINGS

In brackets: the most suitable manufacturers

1. Mechanical dial weigh - redesigned and adapted
   /LIBAL, Celje, Yugoslavia/ 2 pcs
2. Monorail track type K5J-500 2 pcs
3. Hand operated hoist type FDR 250 2 pcs
4. Ladle holder type UK0-200 2 pcs
5. Ladle type KPO 200-200 KGs capacity
   /for items 2-5: CENTROZAP, Poland/
6. Spectrometer type JY 32h, scope of analysis:
   about 15 elements /JOBIN YVON, France/ 1 pc
7. Pyrometer type "Pyropro" 2 pcs
PROGRAM OF FURTHER ACTIONS WHICH SHOULD BE UNDERTAKEN TO IMPROVE THE CENTRIFUGAL CASTING PROCESS IN THE FOUNDRY

Note:

Program indicates only actions which do not require substantial expenses and which can be realized self-reliantly by the technical personnel of the factory - eventually with assistance of the Novi Sad University or UNIDO experts. The actions are listed according to diminishing importance for the factory.

1. Complex of actions and measures aiming to elimination of surface and subsurface defects on castings /with eventual change of mould surface coat, modifier, introducing of obligatory temperature measurements/.

2. Application of partitioned moulds for manufacture of profiled liners, peculiarly on machines CFM-3. Aim: to reduce machining allowances down to about 2 mm.

3. Reconstruction /redesign/ of the pulling mechanism in the carousel centrifugal machine. Aim: to eliminate the very tiring manual operation of "pushing" hot liners from the mechanism and to improve conditions of work.