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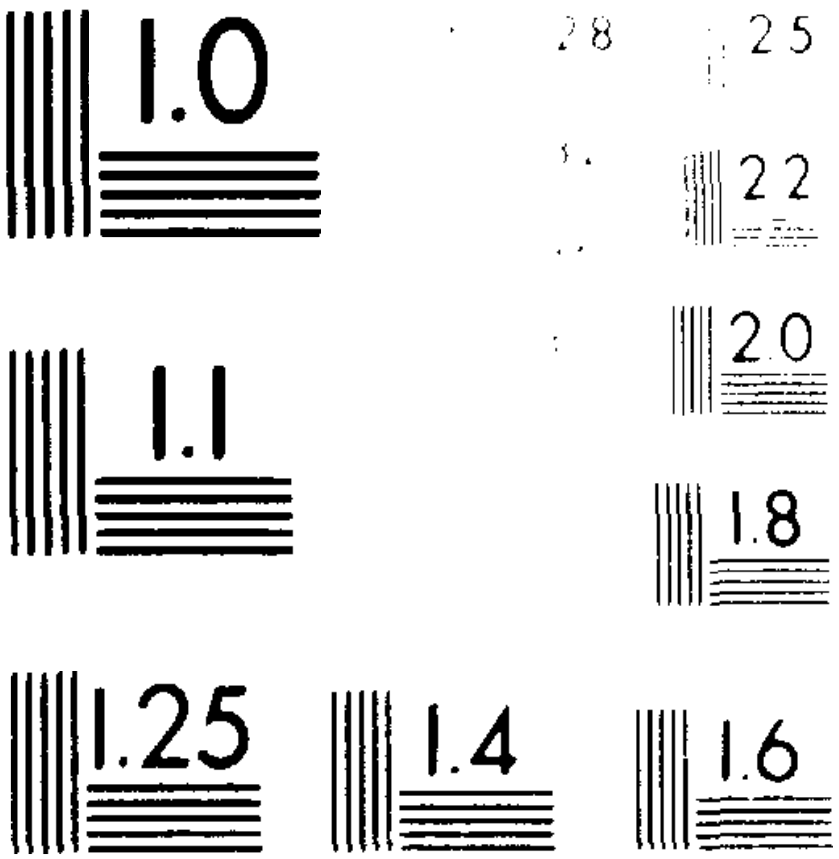

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20 May 1984.

English

Assessing the needs of mould designing - repairing and maintaining as well as the problems of a tool room's establishment.

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FINAL TECHNICAL REPORT

PDR Yemen

Training in mould design, mould making, betterment and creating a tool-room.

Prepared for the Government of People's Democratic Republic of Yemen by the United Nations Industrial Development Organization acting as executing agency for the United Nations Development Programme.

Based on the work of Matyas REUSS, expert in mould fabrication.

United Nations Industrial Development Organization

V I E N N A - A U S T R I A

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I. ABSTRACT

Training in mould design, mould making, betterment and creating a tool-room.

SI/PDY/83/801/ 11 - 03

Assessing the needs of mould designing - repairing and maintaining as well as the problems of a tool-room's establishment.

Duration of the mission 7 weeks/ Aden 11.4.1984 - 21.5.1984, plus flight and briefing and debrifing. Al Gundi Plastics Factory, Aden (established in 1972) with 6 fully automatic injection moulding machines and count about 44 different injection moulds for various, most of them household articles.

The injection moulds are imported from Japan, Denmark, W. Germany, Italy and India.
No considerable maintenance has been available up to the present time, the technological level is low and the greatest problem is the lack of quality control, mould designer and mould making workshop.

The main difficulties are :-

- all machines equipments, devices and materials have to be imported from abroad.
- No experience in mould design, maintenance and betterment has been received although the staff is young and well educated.

They were given an assistance to start with maintenance workshop, to reconstruct and to design moulds and there were discussions about their future developing and training possibilities.

I N T R O D U C T I O N

The three team members for the project Assistance to AL Gundi Plastics Factory (AGPF) in the establishment of Quality Control Laboratory, and Processing of Plastics, Mould Fabrication and Mould Maintenance, arrived in Aden on 11.4.1984 for a 7 week mission. (Aden - P.D.R.Yemen).

The mission was received by Mr. Hasson Mahmoud ABDUL REHMAN Director General and Mr. Nasser Hussein ALALAH Mechanical Engineer, Head of Technical Department. The mission was also introduced to the AGPF counterpart staff/Appendix I/.

The mission visited the UNDP office in Aden and met Mr. Abdul Karim Surani, Deputy Resident Representative, Ms. Katarina Moberg, Programme Officer, Faisal Mahfood Khalifa, Sr. Programme Officer and some of their colleagues.

Members of the mission and their essential assignments were:-

- Dr. K. RAMAMURTHY - Senior Plastics Engineer, Plastics Testing Expert , Institute CIPET, Madras , India.
- Mr. S.A. ARUTJUNOV - Plastics Processing Expert, Chief of Pilot Plant, NPO Plastic, Moscow, USSR.
- Mr. Matyas REUSS - Engineer, Head of Experimental Injection Moulding Group of GTI, Budapest - HUNGARY.

The AL GUNDI Plastics Factory was established in 1972 and started to work with 17 moulds and 3 automatic plastics injection moulding machines. type KUASY, made in the GDR. In 1976 the the factory started to work in 2 shifts, since 1978 in 3 shifts.

The factory has been developed continuously and by now it counts about 44 different injection moulds and 6 automatic machines of the same origin /Appendix II/.

The moulds are received new - with the exception of a few second-hand ones bought in Denmark, from Japan, West Germany, Italy and India.

No considerable maintenance and repairing shop has been available upto the present. The technological basis of the injection moulding is low , however the staff do their best within the possible conditions. One time each year a tool worker's service visit is completed for the maintenance of the moulds, but over and above that there still exists the problem of everyday repairs and the lack of maintenance and betterment of other moulds.

The main constraints in establishing a mould repairing and maintenance workshop and further more a toolroom for new moulds are the following:-

- all the machines, equipments, hand tools and materials Steels, non ferrous metals and auxiliaries have to be imported from abroad.
- Little experience is available in tool maintaining, spare parts making, although the staff is well educated.

The staff were given assistance by the mission to start - step by step , as theconditions permit - with a maintenance and how to make some repairs and spare parts themselves, to save the injection machines vaste time and to prolong both the mould's and the machine's life time.

Discussions were made on the recommendations according to the future developing possibilities and on the exploitation of the maintained machines.

In the light of the local conditions and actual needs in the factory in agreement with the Director General the first three items of the expert's job description have been revised as follows:-

According to the expert's job description and the local conditions in the factory , by the needs and by common consent, the original objectives, the first three items, have been revised as follows:

1. Assessment of existing moulds.
   - Supervise and advise overhauling required for betterment (offers and recommendations).
   - Mould's appropriate lifetime and replacement.

2. Preparation of maintenance programme and proposals of workshop facilities for maintenance.

3. Based on a practical study case propose most appropriate procedure for selection of new moulds, giving due attention to technical and economical factors to be considered in the process of selection.

II - ASSESSMENT OF THE EXISTING MOULDS

The quality and viability of improved production of injection moulded thermoplastic parts depends on :

- mould
- injection moulded technology
- injection moulding machine

with plastics materials available. These three factors are closely interelated.

The assignment was to examine all the factors on injection moulding places based upon the mould and those which may be attributed to the mould.

For this reason great importance has to be given to the mould's repairs and maintenance because many technological problems could be avoided this way.

It would be useful to lay down all the technological parameters their changes, notices and problems during the production with the mould in a schedule for the future and for the next production break, to repair, to maintain the mould.

Every effort should be made that in the second production line the mould should be in perfect condition.

A. Supervision of the Moulds

After having supervised the moulds, most of them look quite good for production, however they all need maintenance, at the least polishing. More or less tool maker's work could make some moulds serviceable once again, and next time we have to think how to make them able to produce a higher output.

Discussions were made on some moulds and the following are recommended to be carried out:

- to polish the cavity surface, spru and runner
- to clean the ejection system, the gliding surfaces, the parting surface-and-lines.
- to clean the cooling system from calcium and incrustation.
- if there are ejection problems, control the cavity of flash, undercutting, damages, the runner and spru surfaces, and the stroke and length of ejection pins and platen.
- if possible, it would be profitable to use rust resisting grease or galvanize or chemically platen the cavity surfaces against oxidation.
- make accurate drawings of the moulds by detailed measuring, to have a full document and to have assistance at overhauling or modernizing e.g. to reconstruct the spru system to a hotrunner one (heated high performance nozzle).

B. Mould's approximate lifetime

Mould's lifetime is rather long and when the suitable possibilities for maintaining, repairing or changing the used-up parts are available, many hundred thousands of pieces can be produced without important dimensions and tolerances.

III - MAINTENANCE PROGRAMME

A. Preparation of maintenance programme

The moulds in AL Gundi Plastic Factory are about 2- 12 years old. Most of them are robust and simple to overhaul several times. Their dimensions and tolerances - with a short exception - are not very important.

AL Gundi Plastic Factory has got a maintenance programme for their machines and moulds which is generally carried out but because of the used machines and moulds the quantity and the quality of this work has been increased, accumulated and changed as well.

The only way is to maintain the most urgent moulds, to assure a smooth production with them in the injection moulding machines. The next step would be to consecutive mould to enter into production in case of a trouble. This system is the most obvious, however it is work intensive but this leads to production and better quality.

B. Offer for a maintenance shop

AL Gundi Plastic Factory has a comprehensive offer for a maintenance shop from WMW Export-Import, GDR. To the start for maintain and repairs work is not all the equipments needed, e.g. the wood working shop, the spot welding machine, also not everything at the first moment when the financial possibilities are not given, however, it would be very useful. But some machines and tools and materials are also missing e.g. hand grinding and polishing machines (about 1500 - 8000 rpm, smaller and bigger one). A sequence of the necessary machines, equipments for a mould maintenance workshop are given in Appendix IV.

** (To maintain to each machine a secon placed consecutive mould)

IV. PROPOSALS FOR THE SELECTION OF NEW MOULDS

New moulds has to comply with lots of requirements and so it's always one's judgement which parameters are more important in a given situation.

Generally the most important requirements are :-

- fully automatic production, exact ejection and dropping out (e.g. ejectors with springs to repeat).
- small rate of runner waste, also suitable with spare parts for other types of thermoplastic material.
- heat treated, brilliant cavity surface, chromium-plated and rust-proof.
- not only for the selected machine suitable
- that uses the 20 - 80% of shot capacity of the available machine.
- as much as possible, but an optimal number of cavities only, to work absolutely sure in fully automatic running.
- tunnel gate and/or self tearing to depart runner and piece.
- proper closing, not only at the max of champing force.
- appropriate cooling system.

V. PROVISIONS FOR THE DESIGNING OF MOULDS

The necessity of drawings, designs of the tools and moulds were also discussed.

Informations, new ideas (See Appendix III) were provided by the mission for designing of new moulds but also for overhauling and betterment and development from semi automatic

to fully automatic function of the used ones.

In the near future a new drawing board and an assortment of drawing instruments will be received and the staff is looking forward to start with the work in a designing bureau.

VI. SUGGESTED TRAINING PROGRAMMES

Practical training is recommended in the following fields:

Design of moulds (drawing, design)
Mould polishers.
Mould repairs and maintenance.
Mould makers, highly skilled mould makers.
Tool room machinery.

After being trained in an institute of good repute such as C I P E T , with an up-to-date mould manufacturing, it is also essential to establish a mould's repairing workshop to follow the training in AL Gund Plastic Factory to adopt and implement the results as well as local training programme into the local practice.

VIII . U T I L I Z A T I O N S

Assessing and reviewing the problems and conditions in AGPF only future utilization can be tackled at this stage of time. The factory will soon move and shift all injection moulding machines to a spacious building where mould maintenance will be feasible and a designing room will be set up, too.

Maintenance, betterment of the moulds and the designing room- - there aren't any documentations of the moulds yet - are the most significant things to step forward in developing production.

RECOMMENDATIONS

The maintenance programme Chapter V. there were lots of ideas for the betterment of moulds and for a maintenance - tool-room. But there are further recommendations :-

- Start first with the simplest polishing, cleaning and maintaining works.
- Make complete documentations about the most problematic moulds, step by step.
- Examine closely the reasons for semi automatic production.
- Examine the saving possibilities in cycle-time waste of material and energy.

For the injection moulding shop:-

- Arrangement of the big machines to serve them later by the existing and reconstructed crane.
- Reconstruct the crane to serve the big machines and the biggest moulds maintenance (longer bridge construction, electric elevating, rails for permanent way to move it easier).
- Use the standardized lifting platforms for equipments fixed on them e.g. grease press, reginder, oil pump, pump for the cleaning the cooling systems, for moulds strong to preserve them.
- Obtain a hand hydrolic platform - lifting - vehicle for the mentioned transport inside the building.
- Obtain electronic temperature and injection pressure control measurements for developing the technology a d to result a better quality.

DETAILS OF COMPANY VISITS

A. Yemen Rubber Manufacturing Company Limited

Crater - Aden. Post Office Box No. 30

Names of persons there:-

MR. HASSON A. HADDAD - General Manager
MR. ABDULLA YAMANI - Chief Engineer

Date 16 April 1984.

Range of work : fabricating slippers; later they'll start with a project of retreading of tyres.

Problems: No rawmaterial control, only practical controls, the slippers surfaces slides at some conditions, they are not trained in mould design, repair and maintenance. (They have a lathe about 1000 mm, a stand drill, a shaping machine and lots of locksmith's devices as well as a new drawing desk).

There are sometimes too big bubbles in the framed sheet.

Questions: To read through their two proforma invoices for the tyre - retreading and to tell our observations and remarks.

B. National Bottling Organization

SHEIKH OTHMAN , Aden.

Names : MR. ALI NOMER - Engineer of the Ministry of Industry, supervising the activity of the National Bottling Organization.

Date : 25 April 1964.

Range of work : bottling and dispatching of soft drinks.

Problems : the crates - each contains of 6 x 4 = 24 bottle cells - are not strong enough, they have two main types of breaking.

- Extreme demands of transport, where we cannot do anything.
- Some crates get broken always at the very same place: the reason for this is a tecinological problem of thermoplastic materials welding and/or soldering lines coming from the four gating of the hot-runner. The solution may be the polishing and maintaining of the mould, to elirinate the need of mould release agent , and to change materials and mould's temperature.

A C K N O W L E D G E M E N T

I would like to thank the Director General of AGDF, Mr. Hasson Mahmood Abdul Rehman and his staff for their efforts to organize and assist our work and to help us to achieve the objectives of this mission. I highly appreciate the continuous performance of all local interpreters.

My thanks are due to all Yemeni people I met for their kindness and hospitality. I would like to mention and thank for the help and good cooperation of my team members of this mission, too.

I also express my gratitude to Mr. R. Gumen - Backstopping Officer for his comprehensive briefing which has helped me to complete my job successfully.

A P P E N D I X I

Counterpart staff at AGPF, Aden.

(1) ALALAH, Nasser Hussein
Mechanical engineer, studied at the Technical University Budapest, Hungary, for 7 years.

(2) KAZI, Anwer Yassin,
Electrical engineer, studied in Varna, Bulgaria.

(3) KHAN, Ashraf Rustam,
Mechnical engineer, studied in Moscow, USSR.

(4) RABEE, Maher Ali,
Maintenance supervisor, studied in GDR for 2 years.

(5) RAHMAN, Hisham Abdul,
Chemical engineer, studied in Baku , USSR.

(6) RAMADAH, Adnan Ahmed
Moulding technician, studied in Aden, had short training in West Germany.

A P P E N D I X II

List of the injection moulding machines :-

	KUASY type	Clamping force MP	Screw diameter mm	Injection volume cm^3
1	250/650	250	53	650
2	260/100	100	45	173
3	25/32	25	28	32
4	260/100	100	45	173
5	100/25	25	28	50
6	1000/4000	1000	125	4800

A P P E N D I X III

List of sketches /s/, tables /T/, books/B/ and articles /A/ as study-aids discussed during the training conversations:-

- Advance Calculation for Moulds/S
- Trial/ current schedule of Technological parameters/s .
- Trial/technological parameters for inj. moulding/s .
- Dates of the moulding material/s .
- Costs of a mould/s .
- O. Heuel: Checklisten for werkeugbestellungen/checklist for ordering inj. moulds, Kstoffe 79/3/A .
- H. Mandler : Technologische UND qualitätssichernde angaben AUF Zeichnungen for thermoplast formteile/important technological and quality data on drawings of inj. moulded thermoplastic parts, plastverarbeiter 76/8 and 423-428/A.
- Notices for drawings of inj. moulded Darts/s.
- Notices for drawings and design of moulds/S.
- Diagram for start and setting the inj. moulding machine with a new mould, faults and their eliminating

  1. Start, filling the mould cavity.
  2. Setting the machine.
  3. After - dressure.
  4. End products faults.

- C. Heinemann ; Werk Stoff UND Ver Arbeitungsgerechtes festlegen von Toleranzen for Kunstoff form- teile. Zum Norm entwurf "Din 16901. Materials and Technological possibilities for tolerances on moulded plastics articles, contributions to DIN 16901/A
- Horndasch/Reuss: 8 advises to inj. moulding/S.
- DIN 16901 standard for plastics mouldings; tolerances and acceptable conditions of Dimensions.
- F. Dralle, H. Gemer; Berchnung Der Wirtschaft-Lichsten form Nestzahl Bei Sprit s-Giesswerkeugen; how to compute the optimal number of cavities for an injection mould? Kstoffe 72/3 and 158-165/A.

- O. Heuel; Anguss-systeme, Synthetic 80/4.
- Hidegbenyoma's, Cold Dieing; Danuvia-Hungary, prospect.
- O. Heuel: Kosteneinsparung Durch Richtige Ausswahl and Behandlung von formenbaustä hlen; how to save cost with the right steel and the right heat treating; workshop hardness tester; Hasco Reprint.
- Hasco Steels, standards, fittings, cartridge heaters , heated nozzles/prospectouses.
- DME info sheet for prefabriacted standards.
- DME heat transfer Rods/Sheet
- DME Hot runner system/sheet.
- Diprofil compr.air machine for filing, grinding, polishing/ prospectous.
- O. Heuel: Drucke UND Druckmessung beim spritzgiessen; mould cavity and injection pressure control through inj. moulding ; plastverar beiter 81/11 /A.
- H. Saechtling: Kunstoff Taschenbuch, C. Hanser Verlag, Munchen, 1977/B.
- H. Gastrow: Beispiel Sammlung für Den spritzguss-Werkzeugbau; C. Hanser Munchen 1966.
- M. Roth: Check - list.
- Demag Kunststofftechnik : Spritzen kurz UND Bündig.

A P P E N D I X IV

Offer for a maintenance shop WMW offer Reg. No. 461/A date 30/9/1983 validity upto 31/3/1984. Orig. total amount US$ 277,908.

Needed machines and devices for moulds maintenance and repairs work; basis for a tool room in order of importance, with a minimum of expense to start with.

MACHINES: All Prices in US$

1. 04.05 Lathe instead of 1400 MM, compl 58674/ a smaller one 800 MM compl. Approx 35000/-
2. 0.09 Bench Dril Compl 4511/-
3. 04.01 Horizontal surface grinding machine 200x600 MM, compl. with electro magnetic table 19921/-
4. 04.06 Universal Milling machine compl/instead of 315x1250 MM 42358/- a smaller one about 300 x 800 MM compl about 32000/-
5. 0.03 Electric Chamber Furnace/instead of 400 x 300 x 600 3595/- a smaller one of 400 / 150 x 100, Laboratory size, 950°C, about 1800/-
6. 03.04 Pillar Drill 4- 32 MM, Spec, Access, Spare Parts, Workbench Equipm, Mandril 9837/-
7. 04.08 UNIV Tool Grinding Machine, Hand Operated with spec, access, spare parts, workbench, universal mandrel and sinus-table included 14567/-
8. 0.08 Arbor Press 3 to 198/-

In the WMW offer not included, but very important and could be placed between 4.5 or 5.6 . Cylindrical Grinding Machine, with internal grinding unit, 200 x 500 MM compl about 28000/-

DEVICES, HAND TOOLS

1. 01.01 3 pcs Job Specific Equipment 1 Set only 1944/-
2. 01.02 Cabinet for Tool 3 148/-
3. 0.12 Steel cabinet for measuring instr. 148/-
4. 05.07 Hand operating Devices 1481/-
5. 01.14 Angle steel Racking Unit, 2 pcs only 131/-
6. 02.05 Workbench 2000 MM but 2 pcs. 430/-
7. 05.02 1 Set Job Spec. Equip. for Electrician 215/-

8.	01.13 Surface Plate, Cast Iron, but not 1000 x 1000 for 398/-, only 600 x 600 MM about	200/-
9.	0.10 Hand Lever Shear	241/-
10.	05.03 1 Set Equp. for Servicing Electrician	86/-
11.	05.06 Electrical Measure and testing Equip.	1590/-
12.	04.02 Tool Cabinet 4 pcs.	276/-
	U S $ ...	152724/-

Important but in the offer not included Hand tools, hand grinding and polishing machines from 1000 to about 8000 RPM, smaller Diprofil and bigger Black and Decker ones, with flexible spindles.

- Parallel Clamps, Joiner's Clamps.
- Sorts of grinding, polishing papers, cloths.
- Hand grinder stones/Rods/ ø ,
- Vernier - Deepness Calipers, Angle Meter, dial indicators with Magnetic bottom, Gauge Blocks, Micro-Meters, Precision straight edge, Vernier high gauge.
- Hardness Tester, see Appendix III.

There aren't any steels, non-ferrous metals, stuff materials /loc-tite 0-ring adhesive set for sorts of 0-rings// Vulkollan-Bayer AG Lever Kusen, W. Germany; Pemü, Budapest, Hungary, blocks for other special stuffs to turn on Lathe/ for mould repairs, for pins, punches, bushings ejectors mentioned, although many sortiments of them would be profitable to have on store or in an accessible nearness.

Some home made devices for surface and polishing work:-

- Rotating table for indicating.
- Polishing Wheel with Rubber-Scretching-Ring.
- Forhead Rubber Spindle for Abrasive Paper/Cloth Discs.
- Inside Files.