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ASSISTANCE THE IRANIAN DEVELOPMENT AND RENOVATION ORGANIZATION /IDRO/ IN DIVERSIFICATION OF PRODUCTION PROGRAMMES OF THE ALUMINIUM PARS FACTORY

SI/IRA/86/867/11-02/J13209

IRAN

Technical report: Development of the manufacturing technology of aluminium foil stocks and foils

Prepared for the Government of Iran by the United Nations Industrial Development Organization, acting as executing agency for United Nations Development Programme

Based on the work of Istvan ACSÁDY, expert in aluminium foil rolling and converting

United Nations Industrial Development Organization

Vienna

378

I. EXPLANATORY NOTES, ABBREVIATIONS

- Value of local currency during the period of the mission
  1 USD = 72,39 Rials

- dross: foam like cover on the top of metal bath in the furnace, collecting the non metallic impurities

- launder: casting channel, jointing the holding furnace to the caster

- rod feeder: motor driven geared device, feeding the grain refining master alloy to the launder in rod form.

- tip: special shaped section at the inlet of the caster introducing the molten metal into the caster shells, generally made of marinite.

- inner shell: the center part of the casting cylinders with water inlet and outlet, specially perforated for cooling water

- cover shell: outside part of the cooling cylinder direcly contacted with the metal strip fitted by heat expansion on the inner shell

- tap hole plug: plug closing the outlet hole of the holding furnace

- belt wrapper : hydraulically operated equipment, wraps the end of the rolled strip around the spool making a hard core of the coil

- Q.C.S. : Quality Control System

- R.A.M.C. : Raw and Aid Material Control

- I.Q.C. : Inprocess Quality Control

- F.P.Q.C. : Finished Product Quality Control

II. ABSTRACT

- Title of post: Expert in Aluminium Rolling Techniques
- Number of the project: SI/IRA/86/867/11-02/J13209
- Objective of the activity: To assist the Iranian Development and Renovation Organization /IDRO/ in the diversification of production programmes of the ALUMINIUM PARS Factory.
- Duration of the activity: from 13.06.1987 till 13.07.1987
- Main conclusions and recommendations:

1. To improve the quality of the aluminium foils it is essential to improve the quality of the foil stocks first.
2. For the manufacturing of good quality foil stocks special raw and aid materials are required continuously for metal cleaning, degasing and grain refining.
3. To improve the casting technic some modifications are to be introduced either in the equipments or in the technology.
4. The environmental protection and working safety are to be further developed on the caster line.
5. The soft cooling water supply of the caster line is to be solved.
6. The cold mill operation is to be further developed by the improvement of the equipment and the technology.
7. Quality Control System is to be improved and further developed.
8. The necessary raw and aid materials checking devices, gauges, controlling equipments education, and technical assistance are to be provided.
9. Follow up programme is proposable to carry out for further development of the manufacturing technology and quality of the foil stocks, plain and converted foils.

III. TABLE OF CONTENTS

INTRODUCTION

The original duration of the mission was two months, but due to the home factory release possibilities it ought to be reduced for one month: from 13th June till 12th July, 1987.

The activity in Iran has started on 14th June and came to an end on 10th July, the actual work in Aluminium Pars Co. lasted from 15th June till 7th July. The staying in Iran included negotiations with UNDP Office Tehran, Aluminium Pars Head Office Tehran, Commercial Section of Hungarian Embassy, Ambassador of Hungarian People's Republic in Iran. The mission also included travelings and two days debriefing in UNIDO Center Vienna.

Due to the difficulties of the back travel at the end of the mission there was only one possibility to leave Tehran for Vienna on 10th July /Friday/ by Swiss Air via Zürich. Upon arrival to Vienna on 10th July debriefing was immediatelly started and completed on 13th July /Monday/. The mission was actually finished by the home travel to Budapest on 13th July, so one day extension was necessary.

Wagon Lits Bureau Budapest cleared the circumstances with the responsible officers in Vienna Center before my departure from Budapest asking for agreement and receiving it concerning the above schedule. /Telex copies were handed over by the occasion of the debriefing/

The original objectives of the mission are given below:

1. General tasks given in the Job Description, were the same as in my last mission in 1986.

2. Actual tasks were given directly by the Back Stopping Office as it follows:

   - Investigation of the present technology of the TECHO-HUNTER caster line
   - Applying earlier proposed and selected experimental metal cleaning, degasing and grain refining materials - provided by UNIDO Center Vienna - carry out experimental run on the caster line to obtain efficiently cleaned and grain refined casted strip as a raw material of a good quality foil stock, suitable for 9 micron foils.
   - Elaborate proposals for further development of the metal cleaning, degasing and grain refining technology.

Extension of the objectives:

In accordance with the requirements of the ALUMINIUM PARS Co. management the following further tasks were given:

- Investigation of the technology of the cold mill line and annealings. Elaborate proposals for the further development of the technologies of the above areas.

- Proposals to reorganise the Quality Control System.

- Consultations on the actual problems of foil rolling, converting, and slitting.

- Delivering lectures on the areas of caster line, quality control, cold mill, and foil rolling, to improve the theoretical, and practical knowledge of plant personnel.

Fulfilment of the tasks:

Within the limitation of the short time available, both the original and the extended objectives were attained.

In accordance with the given tasks detailed investigations were completed on the required areas.

Based upon the findings immediate proposals were elaborated on the caster line, cold mill line, annealings and quality control system.

After obtaining the experimental materials, test running operation was organized and completed applying the proposed technological parameters. Changing the parameters properly fine grain, good quality strip was casted, established by the preliminary laboratory checking. Further checks are under way.

Test running operation was prepared and started on the cold mill line and annealings. The necessary instructions were elaborated in modification of the pass schedules and the homogenization technic.

Individual consulting questions were answered and solutions were proposed to eliminate the actual problems on foil rolling and converting lines.

The required classes were completed in 24 hours with the satisfaction of the audience and management.

In agreement with the plant director, proposals were elaborated about the factory requirements, concerning raw and aid materials, gauges, equipments, education and follow up programs.

Finishing the activity hand written Preliminary Report was handed over on 51 pages in 4 copies, to the plant management.

Supporting my activity all the necessary help was given to me by plant and company management, UNDP Office, UNIDO Center Vienna, and Hungarian Embassy. The working links and conditions were as excellent as by the occasion of my last year mission, all the partners were constructive and helpful.

RECOMMENDATIONS

A. Caster line

1. Melting furnace.

- Charging of the ingots is to be improved to avoid the damage of the bottom of the furnace.

- When producing foil stocks no scrap charging is recommended.

- Alloying by master alloys the ingot form and the application of perforated steel basket is proposed.

- Both cleaning and degasing process is to be applied in melting furnace as well, for foil stocks materials. Salts are to be charged in tablet or in powder form.

2. Holding furnace.

- The presently applied cleaning and degasing system is advisable to be improved using hexachlor ethane in powder form, applying powder injector by means of nitrogen gas.

- Introduction of the measuring the residual hydrogen gas concentration and non-metallic impurities, enclosures, are essentially important.

- The grain refining is necessary to be applied not only for alloys but for foil stocks as well.

- The grain refining process can be applied either in the holding furnace /ingot or tablet form/ or in the launder /rod form/.

- The most effective grain refining process is the application of titanium diboride /AlTi5B02/, when TI/B rate is 5/1 applying the correctly set rod feeder. The present setting is to be modified on the explained way.

- Filtering of the metal in the launder is essentially important.

- To improve the working conditions the efficiency of the exhausting system above the melting and holding furnace is to be modified.

3. Caster.

- Modification of the presently used tip construction is recommended, applying individual metal introduction into each section.

- Checking the possibility to increase the cooling effect on the middle part of the shell is proposable.

- It is necessary to measure the returning cooling water temperature after the shells individually, and to measure the surface temperature of the shells and the casted strips, on different points.

- The reorganization of the cooling water supply of the caster line is recommended; perfectly cleaned and softened water is to be applied on the line.

- To reduce the crown hight of the casted strips in the middle part 3 ways are proposable:

a./ increasing the crown of the cover shell
b./ improving the cooling effect in the inner shell
c./ optimalization of the production programmes concerning the width selection /starting with the widest strip, continued always by narrower one, finally change the shell/.

- Surface quality of the casted strip is to be improved on the following ways:

a./ applying finer grain of the grinding wheels and better finish at the grinding of the shells
b./ using graphite based lubricant for casting.

B. Quality Control System /Q.C.S./

1. General.

The Q.C.S. is advisable to be further developed, the necessary personnel conditions, devices, and organization are to be provided in accordance with the main questions of the Q.C.S.

2. Areas of the Q.C.S.

The reorganization is to be extended on the following main areas of the Q.C.S.:

a./ Raw and Aid Material Control /R..M.C./
b./ Inprocess Quality Control /I.Q.C./
c./ Finished Product Quality Control /F.P.Q.C./

3. Assurance of the Quality.

To assure and to increase the quality level of the products it is essential to recognize and to collect all the possible quality errors at all working places in all the phases of the production technology for the perfect preparation of the reorganization of the I.Q.C. /details see in para IV.2./.

C. Cold mill line

1. Marking of the work rolls and strips.

- The main possible reasons of the problem are the following:

a./ serious mechanical slipping effect between back up and work rolls
b./ slipping between work roll and strip
c./ slipping amongst the threads of the coil
d./ non metallic impurities in the metal.

- To eliminate the problem the following measures are recommended to be taken:

a./ to avoid the slipping effect between the work roll and back up roll an automatic electrohydraulic interlock system is necessary, to ensure the required value of the separating force, when there is no strip in the rolling gap.

b./ Reduction and roll surface conditions are to be kept within the correct limits to avoid the slipping between the work rolls and the strip.

c./ Lubricating conditions should be perfect to avoid the metal /metal friction /rolling oil quality/.

d./ The correct tension setting and automatic controlling is necessary to avoid the slipping of the coil threads.

e./ Applying proper metal cleaning and degasing technology the non-metallic impurities are to be eliminated.

2. Homogenizing, pass schedule.

- After casting the strip homogenizing is proposable for alloys and for foil stocks as well to ensure the better formability of the foils.

- Applying the homogenization one intermediate annealing is sufficient instead of the presently used two ones so more energy consumption is not required.

- The pass schedules are to be improved taking into consideration the proposed theoretical figures and the homogenization.

3. Rolling operations.

- The flatness, shape of the casted strips, and the accuracy of the thickness can be improved on the following ways:

a./ by the improvement of the cooling conditions
b./ proper selection of the rolling speeds
c./ improvement of the roll grinding conditions
d./ improvement of the shape of the casted strip
e./ applying an up to date automatic shape control system
f./ applying automatic gap control system.

- The threading operation is to be improved to ensure a tight core of each coil.

- The application of the oil eliminator air blow is to be corrected to avoid excess oily surface at the end of the coils.

- The rolling base oil quality must be on the same level as GEREX 57 to obtain perfect lubricating conditions.

4. Experimental rolling on the cold mill.

- The evaluation of the started experimental rollings is recommended, to realize the advantages of the experimental metal cleaning, degazing, grain rafining, homogenizing and pass schedule optimization. The proposable areas of the evaluation:

a./ rollability, formability
b./ mechanical properties
c./ homogenity
d./ non metallic enclosures, grain structure
e./ porosity in 9 micron foil.

D. Foil rolling

In accordance with the information obtained rolling personnel could improve their technic based on my last year activity. All the proposals and establishments in my last year technical report are still valid. Amongst them there are some essential items to be emphasized:

1. Roll grinding:

- Application of the 320 K grinding stone at the thin foil finish passes is essentially important.

- The crowns of the work rolls for thin foil rolling can be further increased /1st and 2nd pass: 70 micron, 3rd pass: 90-100 micron, 4th and 5th pass: 110-120 micron/.

- The required crown hight depends on the width of the foil. The wider foil requires higher crown, and vice verse.

2. Rolling oil:

The cleaning, filtering of the oil is to be further improved. The quality of the base oil is to be kept on the level of GENREX 56.

3. Shape control.

Separating and reversing system is helpful for cold starting of the mill, but not suitable for eliminating assimetric shape errors. Preload pressure and roll cooling are recommended as the main factors of the shape control.

4. Mill starting torque, threading conditions.

The conditions are to be improved to ensure the mill running with threading speed, when the necessary preload pressure and pay off tension is on.

5. Mills rewind side modification.

The second guide roller is to be set at the rewind side of the mills.

6. The threading system applied on the doublepay off should be in accordance with the shape of the foils are to be doubled. Setting of a separate control box on the pay off side is necessary for the double decoilers.

7. The good quality of the foil stock is the basic requirement of the good quality of the thin foils. The main points are to be considered:

a./ preferable alloy selection
b./ perfect metal cleaning, degasing, alloying, and grain refining technology
c./ perfect casting technology
d./ homogenizing of the casted strips
e./ perfect cold rolling, trimming, spooling and handling technology
f./ high levelled Quality Control System
g./ factory foil stock standard.

B. Foil converting

1. Quality of the plain foils

The quality errors of the plain foils, which were discovered are to be eliminated on the explained ways to obtain a perfect raw material for converting. The main errors:

- shape, flatness problems
- surface quality problems: grisy-oily surface, oil stain, water stain, burnt oil spots, small, sticky deoiling.

2. Wet lamination

- Selection of the suitable quality water based adhesives, and papers is essentially necessary in accordance with the application areas.

- The wet lamination technological parameters are to be elaborated taking into consideration the technical possibilities of the laminating machine.

3. [redacted]

- Selection of suitable quality plastic films and solvent based adhesives are necessary taking into consideration the home market possibilities as well.

- Theoretical and practical knowledges of the dry lamination technology are to be further improved.

- Setting of the Corona-treating device is necessary on the dry laminating machine.

4. Heat sealable lacquers

Up to date recepies are to be applied based on UNION CARBIDE resins.

5. New combinations

The palet of the presently produced combinations is proposable to be extended applying wet, dry and wax laminating and hot melt coating technic to supply new products for diary-, sweet-, tabacco industry, coffee, fruit juces and other food packaging industries.

F. Slitting

1. Grinding of male and female knives.

- Introducing the grinding of the weared knifes is seriously recommended to maintain constant slitting conditions and good slitting quality, and reducing the production costs.

- Suitable angularity is to be applied for the different materials are to be slitted.

- To put the existing knife grinding machine into operation is essentially important.

2. Further improvement of the slitting quality.

- The quality of the laminates to be slitted is advisable to be improved.

- The slitting technic of the operators is to be further developed.

C. Technical developing questions

1. Follow up programme

Studying the present situation in the Aluminium Pars Company, taking the actual and realistic requirements and necessities into consideration the following UNIDO Project is recommended for the "Production and product development assistance to Aluminium Pars Company".

Table No.1.

I. NO	OBJECT	PER-SON	DUR-MONTH	MEN/MONTH	C/DAY, MONTH USD	TOTAL USD
	EXPERTS					
1.	Chief technical adviser	1	6	6	12 000/M	72 000
2.	Expert-caster line	1	2	2	10 000/M	20 000
3.	Expert-cold mill	1	2	2	10 000/M	20 000
4.	Expert-pigment technology	1	6	6	10 000/M	60 000
5.	Expert-pigment quality control	1	3	3	10 000/M	30 000
6.	UNIDO-UNDP mission					8.000
7.	EXPERTS TOTAL					210 000
	TRAINING					
8.	Study tours for ALUM.PARS experts	6	0,5	3	75/D+A.T.	19 000
9.	Fellowship-foil rolling	5	2	10	75/D+A.T.	32.500
10.	Fellowship-foil converting	5	2	10	75/D+A.T.	32 500
11.	Fellowship-pigment technology	5	2	10	75/D+A.T.	32.500
12.	TRAINING TOTAL					116 500
	SUBCONTRACT - FURNEY PROJECT					
13.	Basic engineering design					100.000

continued on Table No.2.

D.A.T. = Air ticket

Table No. 2.

I. NO	OBJECT	PC	ESTIMATED PRICE/PC USD	TOTAL USD
	EQUIPMENTS			
14.	Automatic strip breaker for foil mills	2	6 000	12.000
15.	Meter counter for foil separators	2	1 000	2 000
16.	Roll crown measuring device	1	4 000	4.000
17.	Measuring dev. for hydrogen concentration	2	1 000	2.000
18.	Measuring equipment for impurities	1	12 000	12.000
19.	Thickness measuring gauge for thin foils	5	100	500
20.	Automatic temp.control for rolling oil	2	10 000	20.000
21.	Automatic thickness control extension	2	65 000	130 000
22.	Surface temperature measuring device	5	1 000	5.000
23.	Gap measuring device for extruder	1	50 000	50.000
24.	Instruments and controls for pigment project		500 000	500.000
25.	EQUIPMENTS TOTAL			737 500
26.	Miscellaneous			20 000
	SUMMARY /7+12+13+25+26/			
	EXPERTS			210.000
	TRAINING			116.500
	SUBCONTRACT-PIGMENT			100 000
	EQUIPMENTS			737 500
	MISCELLANEOUS			20 000
	PROJECT TOTAL			1 184.000 USD

2. Raw and aid materials

In addition to the programme given above the company needs different raw and aid materials to improve the technology and the quality, and to extend the product palette:

- metal cleaning, degasing and grain refining materials
- active filter metarials for rolling oil filtering
- grinding wheels for work and support rolls grinding
- plastic films for laminating
- wet and dry laminating adhesives
- combined aluminium foils ready for printing

These materials can be provided by different foreign companies through international cooperation. The necessary information was handed over.

3. Education

- Scholarship for five Iranian students/year in different Hungarian universities, offered by the Hungarian Government.

- Further practical and theoretical education is available for Iranian technical people in Hungary, based on the Technical and Scientific Cooperation Contract between Iran and Hungary.

IV. ACTIVITIES AND OUTPUT

A. Caster department

1. Melting furnace:

Existing parameters:

- Capacity of the furnace: 20-25 tons
- Heating: by means of oil
- Charging: by trucks
- Raw materials: Supplied by Arak Works in ingot form, weight: 500 kg/ingot. Chemical composition Al. 99,67 and 99,3 /Alloy: 1060 and 1230/
- Charging quantities: 2 times/shift. One charge: Appr. 4 tons, alltogether 8 tons as an average.

Max.charge: 12 tons/shift, depending on casting speed and width.

Charging of the scraps recycled: Applied, even for foils as well occasionally. Max. quantity of scrap: 25 %, quality: alloy 1000.

- Melting technologie, metal handling, treatment:

Cleaning of the inside wall of the furnace: By means of "COVERALL" salt - Supplier: Foseco.

Cleaning of the metal: By means of "COVERFLUX" salt, supplier: Foseco, applied on the top of the metal bath by hand. Quantity: 2 times/shift, 5-5 kg/charge, totally: 10-max 13 kg/shift. Removing of the dross: 2 times/shift. Degassing: Not applied in the melting furnace.

- Temperature in the furnace: 750-760 °C
- Alloying:

Typical alloys produced: 1230, 1145, 1100, 1050, 3003, 3004, 3005, /5005, 5010 occasionally/

Master alloys applied: AL/MN /60 %/, AL/MG /25 %/, AL/FE /25 %/ not appl. continously, prefered iron strip/, AL/TI /45/1 %/ AL/SI: Not applied.

Charging of the master alloys: The AL/MN alloys are grinded and spread on the top of the bath by hand in granulated form, into the melting furnace. The others are charged in billet form.

H2 gas content: not measured.

2. Holding furnace

Existing parameters:

- Capacity of the furnace: 10 tons
- Heating: By means of oil
- Temperature in the furnace:
  Starting: 730 °C /beginning of the cast/
  Later : 680 °C /during the cast/
- Metal treatment, holding technology:

A./ Degasing, cleaning:

- By means of N_2 gas applied through, steel pipe, moved on the bottom of the furnace
- By means of "POSECO REGD" tablets, 4x6 tablets/shift, charged by a perforated steel basket.

B./ Grain refining:

Experimental runs by an Iranian made material. There are no more details.

C./ Dross removal: 2 times/shift

D./ Mixing: 4 times/shift, to obtain a homogeneous bath.

Sequence of the above processes is not prescribed.

H2 gas content: Not measured.

3. Casting

- From the holding furnace the molten metal flows into the casting chanel /launder/ through the automatic level control, which controls the opening of the closing plug of the furnace. The casting chanel leads the metal as far as the head box where it will be level controlled again. Temperature in the chanel: 690 °C
- Filtering: For the moment not applied. Generally the filter is built in the chanel before the head box.
- Rod feeder: Not applied.
- Inside covering of chanel: MARKITE
- Head box, deviders
- Casting machine: Type: TECHO-HUNTER normal caster.

Main parameters:

- Width: Max: 1570 mm, min: 1060 mm.
- Thickness: 4-9 mm.
- Casting speed: 0,8-2 m/min theoretical
  0,9-1 m/min practical
- Cooling water: Pressure: 0,9 Atm
  Input temperature: 24 °C - 24 °C /both shells/
  Output temperature: Not measurable
- Cover shell crown: Min. 0,2 mm
  Max. 0,4 mm
- Lubrication of the shells: $Mg/OH/_2$
- Pinch rollers: 2 pairs
- Loop control: not applied
- Guide rollers: OK
- Edger rollers: to set the width and make the edge more correct.
- Sheare: Guillotin type
- Roller leveller: OK
- Coiler: D.C. driven
- Temperature of casted strip:
  After the caster: Appr. 200 °C
  At the coiler : Appr. 100 °C
- Content of gas: Not measured

4. Notes and proposals on casting line

4.1 Melting furnace:

- Charging of the ingots: When charging, the ingot falls down in the furnace damaging the bottom of it reducing the life time of the furnace, generating mechanical impurities in the metal /foil pinholes!/.

- Proposal: Modification of the lifting head of the truck applying a slipping way in the furnace.

- Charging scraps when producing foil stock:

Occasionally foil and other scraps are charged, up to 25 % into the melting furnace to foil stock metal base.

- Proposal:

In accordance with international experiances no scrap charging is seriously advised when producing foil stock materials. The impurities born on scraps have bad influences in the quality of the thin foils /increasing pinhole number, getting the rollability worse/.

- Alloying system:

The master alloys are grinded, and spread on the top of the metal bath by hand for the moment.

- Proposal:

Concerning magnesium master alloy it is advised to charge it in block /ingot form/, to avoid the significant loss of magnesium by sparking, applying perforated steel basket tool. Many companies use this system for all the master alloys including efficient mixing of the bath, or introduce the master alloy in wire /rod/ form, by rod feeder. /see para 4.2./

- Metal cleaning, degasing:

Metal cleaning applied by "COVERFLUX" salt 10-13 kg/shift, that means 1,25-1,08 kg salt/tons metal in accordance with 8-12 tons charge of ingots. Degasing is not applied in the melting furnace.

- Proposals:

The presently applied methods seem to be not quite sufficiant, suggested to be improved. Both cleaning and degasing processes are to be applied in melting furnace, too specially, when making foil stocks. The methods are generally applied and proposable as follows:

4.1.1. Tablet form:

Charging of tablets by means of perforated steal "basket" tool. Type of the tablet: A./ ALUFLUX M 50 salt

Supplier: SERVIMETAL, Adress: 235 Avenue ALSACE-LORRAINE, 73003 CHAMBERY CEDEX, FRANCE

B. / KMS 1000 50 salt

Supplier: KRICH BARTH Co. OHG.

A 3423 St.ANDRAE-WÖRDERN Edvard-Klinge Str. 6. AUSTRIA

Quantities generally applied of the above tablets:

For foil stock, Alloy 1235 : Scrap: 0

3.5 kg tablet/ton metal

For Alloys 3003 and 3004 : 0 /Not in melting f./
Recycled scrap supposed.

4.1.2. Salt in powder form:

Charging of the salt powder by means of nitrogen gas stream, applying specially designed injecting feeding system.

- Pressure of the nitrogen: 0,3 - 0,5 atm
- Duration of the process: at least 10 M/H
- Next should make the dedrossing.

Type of salt powders:

A./ ALUFLUX H 50 - SERVIMETAL
B./ KBA T 1000 50 - ERICH BARTH CO.
C./ FOSECO hexachlor-ethane - FOSECO
Adress: AUSTRIA 5412 PUCH, bei HALLEIN.

Quantities are generally applied:
for foil stock, Alloy 1235, Scrap: 0
1.75 kg/ton metal

For Alloy 3003 and 3004 : 0 /Not in melting f./
Recycled scrap supposed.

Note: The metal treatment by salt tablets is never so effective, as the nitrogen injected salt powder. The consumption of tablet is always the double of the salt powder. The quantities are depending upon the ingot/scrap rate.

4.1.3. **ALPUR SYSTEM:** After holding furnace.

Gas mixture:

Argon + Chlorine

Chlorine: 0-5 %

Flow rate: a./ 3-14 Nm^3/h

b./ 10-30 Nm^3/h

Rotor: 120 - 250 rpm.

Heating: Immersion heater /electric/

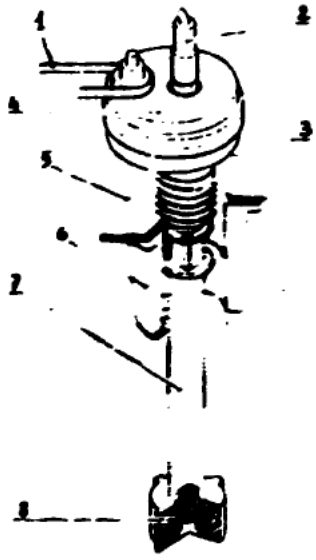
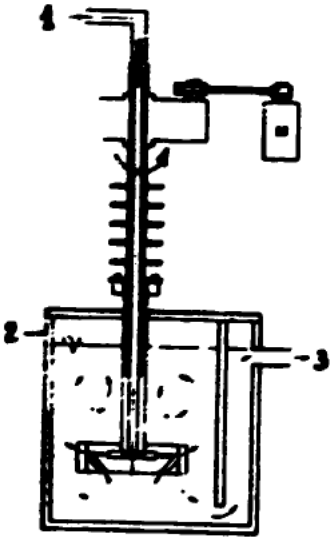


Figure 4 - ALPUR rotary mixer

1 Driving belt
2 Rotative gas feedthrough
3 Cooling flanges
4 Reducing gear
5 Support arm
6 Pin
7 Rotor shaft
8 Rotor



1 Gas inlet
2 Metal inlet
3 Metal outlet

Figure 5 - Principle of the ALPUR treatment vessel

- ALPUR System is situated between the holding furnace and the casting station.

- Advantages:

1. High efficiency of degasing: Up to 80 % of the initial
2. High efficiency of cleaning:
3. Tiltable, so easy to emptying, and dedrossing
4. Easy to install on a casting unit
5. Low maintenance costs.

4.2. Holding furnace:

- Metal treatment:

The presently applied degasing, cleaning and mixing system looks to be careful, but there are possibilities to improve. Grain refining is in the holding furnace only experimental.

Proposals:

However - in accordance with experiances - the following treatments are proposable.

4.2.1. Cleaning degasing by tablets /Not high efficiency/

- ALUFLUX H 50 /see 4.1./
- KBA T 1000 50 "

Quantities of the tablets are to be charged:

For foil stock, Alloy: 1235 : 4 kg/ton metal

For Alloy 3003, 3004 : 2.5 kg/ton metal

4.2.2. Cleaning, degasing by nitrogen injected salt powder /Much higher efficiancy/

Materials are the same as that of para 4.1.

Quantities:

For foil stock, Alloy: 1235 : 2 kg/ton metal

For Alloy 3003, 3004 : 1,25 kg/ton metal

Quantity required is always half of the tablet.

Note: At least 20 min. treatment is necessary, ensuring a good movement of all parts of the metal bath.

The hydrogen gas content can be reduced as far as the below given figures, applying the above treatment:

For foil stock, Alloy 1235 : 0,05 cm^3 H_2/100 g metal

For Alloy 3003, 3004 : 0,1 cm^3 H_2/100 g metal

There is no H_2 concentration checking on the caster line, due to the lack of the measuring device. Seriously advised the urgent introduction of this check.

4.2.3. ALPUR SYSTEM /Highest efficiancy/

The system is to be applied between the holding furnace and the casting station /See par. 4.1.3./ The efficiancy of the treatment is depending on two main parameters: Gas flow rate and revolution of the rotor.

Diagram given below:

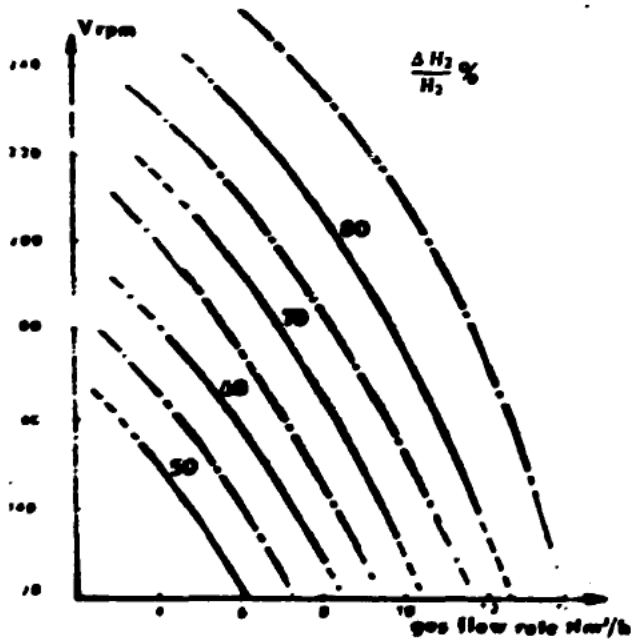


Figure 3.

$$\frac{\Delta H_2}{H_2} = \frac{H_2 \text{ content before ALPUR} - H_2 \text{ content after ALPUR}}{H_2 \text{ content before ALPUR}}$$

Supplier: PECHINEY ALUMINIUM ENGINEERING
Zone Industrialle - B.P. 24. 38340 VOREPPE - FRANCE
Telex: 980732 F

4.2.4. Grain refining:

Presently grain refining is applied only for Alloys 3003, 3004 and others, but not for foil stock. The process is carried out by means of tablets in the holding furnace.

Proposal:

- Grain refining is essentially used not only for alloys, but for foil stocks as well. The most advanced process is made not in the holding furnace, but in the launder, applying the rod feeder. /See in details in para. 4.3./

Material: AlTi5B02 master alloy.

The methods are generally . applied:

A./ Charging in sheet billet form in the holding furnace:

Applying perforated basket, under the level of the bath.

Quantities: For foils: 2 kg/ton metal /No scrap/

For Alloy 3003, 3004 : 1,2 kg/ton metal /No scrap/

Applying 100 % scrap for Alloy 3003, 3004 : 0,5 kg/ton metal

B./ Charging in tablet form in the holding furnace:

Applying perforated basket

Material: TILITE 101 salt 40 % Ti cont.

Quantities: the same as for sheet form.

C./ Charging in rod form in the launder:

Applying rod feeder

Quantities: For foils: 1 kg/ton metal /No scrap/

For Alloy 3003, 3004 : 0,6 kg/ton metal /No scrap/

Applying 100 % scrap for Alloy 3003, 3004 : 0,2 kg/ton metal.

4.3. Casting

4.3.1. Launder

The MAGNESITE covered chanel including the tap hole plug, level controls, and head box, looks to be in sufficient condition. Filter is not applied for the moment. Temperature: Starting 730 °C, in the launder: 690 °C.

Proposal:

- Filtering is definitely necessary in all cases, specially for foil stocks, at least in the head box or near the head box.

- Casting temperature generally proposable as low as it possible technologically.

4.3.2. Rod feeder, grain refining:

The equipment is out of use since nearly one year. Experiances are not quite good with it. According to the present practice the grain refining rod was introduced in the head box or near to the head box. Grain refining was applied only for Alloy 3003.

Proposals:

- The application of the rod feeder is seriously advised, after the necessary maintenance.

- The control box of the rod feeder is to be shilded from the direct heat radiation.

- The immersion point of the rod is not correct for the moment, suggested to be supervised.

In accordance with international experiances, and advises of rod feeder suppliers the following conditions are necessary to be ensured to obtain the proper effect of the rod feeder:

A./ Immersion point of the rod is close to the holding furnace tunhole, where the temperature is the highest and the speed of the metal is fastest, so the conditions are optimal for the quick dissolving of the rod.

B./ Direction of the rod motion always opposite to the metal.

C./ The angle of the rod to the horizontal is 60 ° or less, to avoid the damaging of the launder bottom.

D./ If necessary guiding pipe of 1" dia is to be applied. Minimum bend radius of 50 cm recommended.

4.3.3. Theory of grain refining:

- The function of the grain refiner is to form nucleis /cores/ in the melt, which facilitate the formation of the crystallites around theese cores. The grain refiner generally is a compound material.

- The presence of at least small concentration of other alloying elements dissolved in the metal prevent the crystal growing.

- KAWECKI AlTi5B02 is an excellent material. Applying special technology the titanium diboride is dispersed in so fine particles form in the alloy, that is below the limit of the visibility of an optical microscope.

- It is essential that the Ti/B rate is 5:1, so in the particles the presence of the titanium of is always in some excess, while there is no free or uncombined boron. Adding this combined material to the melt the nuclcis are provided, around which the crystals are formulated as the metal cools, while the excess of the titanium acting with the other alloying elements prevents the crystal growing.

- Due to the extremly small size of the TIBO2 particles these will not settle to the bottom of the metal, but remain flotating, in suspension for in indefinite period of time.

- The charging of the master alloy is recommended to carry out generally as late as possible just before the casting either in the holding furnace /below the metal surface/ or in the launder /the most advanced method/.

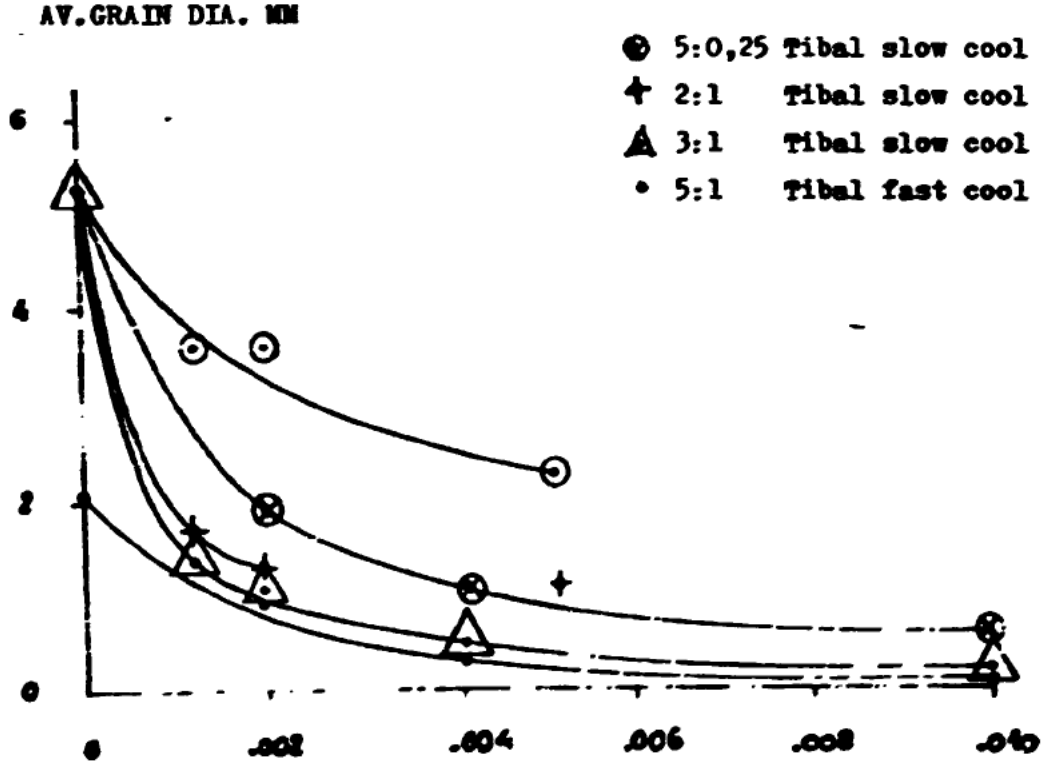
- Quantities to use: Depend on many factors:

A./ The equipment contruction and size
B./ Size and time schedule of the operation
C./ The amount of the scrap recycled
D./ Quality standards
E./ Plant own experiances

To set the necessary Ti concentration it is proposable to apply the following table:

TIBOR ADDED	Ti ADDED	B ADDED
1/2 kg/ton metal	0,0025 %	0,0005 %
1 -"-	0,005 %	0,001 %
1 1/2 -"-	0,0075 %	0,0015 %
2 -"-	0,01 %	0,002 %
2 1/2 -"-	0,0125 %	0,0025 %
3 -"-	0,015 %	0,003 %

The efficiancy of TIBOR/AL master alloy can be seen on the diagram below



Weight Percent Titanium
Grain Refinement of 3003 Aluminum

Figure 4.

- Special advantages of KAWECKI TIBOR:

A./ Finest dispersion of TIBOR maximum grain refining

B./ The fine grain is obtained by addition only a small quantity of titanium /anodising-reflectivity/

C./ Compared with salts, TIBOR is cleaner and less waste /at least 20 % salt is lost in form of fume/

D./ Increased casting speed

E./ Reduced scraps.

4.4. Caster

4.4.1. Tip construction, and effects on grain:

Tip construction applied for the moment has only one metal introduction in the middle. The grains are always bigger sized in the middle than on the sides. Sticky brakes, holes in the middle part are occasionally found.

Proposal:

It is a good idea - in accordance with the original Hunter documentation - to apply a separate metal introduction for each individual tip section. There is an other way to increase the cooling effect in the middle of the shell, modifying the water sprays sizes or numbers of the inner shell.

4.4.2. Parameter of Caster:

To have better possibility to keep the technology in hand more of the information should be obtained for the operator. e.g. returning water temperature separately, surface temperature of the casted strip on both sides and middle, shape of the casted strip.

Proposal:

Introduction the measuring of the above parameters.

4.4.3. Grain conditions

Besides the observations of para. 4.4.1. the grain sizes are always bigger on the top side of the strip than on the bottom one.

To apply a separate metal introduction for each individual tip section.

Proposal:

In accordance with laboratory checks, the problem is not originated by different concentration of alloying elements, because they are practically the same. Rather supposable the not equal cooling effect on both sides. Therefore it is necessary the individual measuring and temperature control of the shells. Moreover serious grain refining is necessary.

4.4.4. Cooling water quality, cooling effects

It is due to the not treated quality of the cooling water, which contains a lot of $CaCO_3$, it will be deposited seriously on the surface of the inner shell, blocking the spraying holes partly or totally, covering the inner surface of the cover shell as well. These conditions have an uncontrolable bad effect on the cooling surfaces of the shells, badly influencing the quality of the casted strip.

Proposal:

It is very necessary to put the separated water cooling, softening and cleaning system into operation to improve the quality of the casted strip and keep it constant.

4.4.5. Shape conditions:

It is typical that the shape of the casted strip is not correct, always heavier in the middle part, than in the side of the strip.

Proposal:

The problem can be solved either by increasing the camber of the shells, or improve the cooling effects in the middle section of the shells /see para 4.4.1./, or increasing the cover shell grinded crown, or apply crown on the pinch rollers.

- Optimalization of production programmes by correct width selection. I propose to start with the widest web, than continue with the narrower-narrower sizes as far as the minimum and then change the shell. Never turn back after a narrow width to a wider one, to avoid the narrow size marking on the wider strip.

4.4.6. Surface conditions

- The grinding conditions of cover shell are to be supervised. Suggested to select finer grinding stone, to obtain better surface of the casted strip.

- Presently applied shell lubricating material: Bentomit. The effect is not perfect. The casted strip shows sticky appearences, and water stain spots are observable at cold mill.

Proposal:

Application of graphite based lubricant is preferable.

B. Quality Control System

1. System applied in the plant recently:

1.1. Caster line:

- Sampling full width of the casted strip checking the thickness on 7 different places on 7 mm casted strip, establisment of the crown.

- Flatness: measuring the difference between the middle and different other parts of the sheet.

- H_2 gas concentration: not measured

- Grain size: Applying standard samples, the grain size evaluated ordinary, and classified like "very fine", "fine", "middle", "coarse", "very coarse", on the 7 mm casted strip.

- Chemical composition: ordinary checked for the basic and alloying elements: Si, Fe, Cu, Mn, Mg, Zn, Ti.

1.2. Cold mill, foil mills:

- Outside appearence of the coils: flatness, thickness, winding, trimming, are checked.

- Mechanical properties are checked occasionally after the final passes of the cold mill.

- Inprocess control: Flatness, thickness, surface quality, holes, porosity are checked by the plant personnal.

1.3. Final checking after annealing:

- In accordance with the order and requirements of the customer, the parameters given below are checked: thickness, width, mechanical properties, grain test. Checkings are made by quality control organization.

2. Notes and proposals on the quality control system:

2.1. Generally about the Quality Control System:

2.1.1. The main purposes of the Q.C.S.:

A./ To establish the quality errors

B./ To determine the parameters of the good quality /home standards/

C./ To maintain and improve the quality of the products.

D./ To fulfil the requirements of the customers, and improve the image of the company.

E./ Reducing the material losses /inprocess and reclamations/ decreasing the production costs.

2.1.2. The main questions of the Q.C.S.:

A./ WHO? /organization, person/
B./ WHEN? /which phase of the production/
C./ WHAT? /which parameters, characteristics/
D./ BY WHICH MEANS? /device, equipment/
E./ HOW? /method, process, way/

} should do the checking

2.1.3. Main characteristics of the Q.C.S.:

The quality control should be performed:

- ORDINARY
- CONTINUOUSLY
- SYSTEMATICALLY
- OVERALLY

2.2. The main areas of Q.C.S.:

2.2.1. Quality checking of the raw and aid materials /R.A.M.C./

- Determining the raw and aid materials.
- The raw material: is an organic part of the finished product /e.g. alufoil in a combined laminated foil./
- The aid material is taking part in the technological process but can not be observed in the finished product /e.g. solvent or rolling oil/.
- The standpoints of the checking:

A./ Shipping documents, certificates of the quality

B./ Inspection of the goods, packaging damages etc.

C./ Identification of the goods, comparing with the original order /based on documentation, but if it is necessary laboratory checks / quality/quantity check.

D./ Storage

- The personnel who makes the checking:

A./ Store

B./ Q.C.S. /laboratory/

C./ Commercial section

- The main questions of para 2.1.2. are to be determined.

2.2.2. Inprocess Quality Control /I.Q.C./

Determination:

- Extent of the I.Q.C.: Covers all the phases of the production.
- Purpose: To discover the quality errors as early as possible, to prevent the enlarging or multiplication of the errors. To help to keep up a constant technology.

2.2.3. Preparation of the I.Q.C.

- Discovering of the sources of the quality errors:

In all departments, all working places all the possible quality errors, troubles are to be collected, registered in order to the technological processes. It is advisable to note the trouble shooting immediately as well. The working table given below is recommended:

e.g.

Department: Caster Line

Table No. 3.

No.	WORK PLACE, PROCESS	ERROR, TROUBLE	REASON	TROUBLE SHOOTING
1.	Charging of the ingot	Damage of furnace	The ingot motion incorrect	More careful operation of track
2.	Melting furnace -Cleaning -Degasing -Alloying -Dedrossing -Sampling	Impurities in metal. Excess H_2 gas content dispersion or quantity is not correct	Cleaning not sufficiant. Degasing not sufficiant alloying system is incorrect	Appl.correct cleaning material and techn. appl. correct degasing materials and technology, appl. perforated basket tool
3.	Holding furnace -Cleaning -Degasing -Grain refining -Mixing -Sampling			
4.	Launder -Level control -Rod feeder -Filter -Head box			
5.	Caster -Tip -Shells -Pinch rolls -Loop control			

2.2.4. Introduction of the I.Q.C.:

After the evaluation of the quality errors, troubles, the main questions of the Q.C.S. are to be answered, or decided. The following working table is proposable:

Department:

Table No. 4.

No.	Error what? trouble qual.parameter	Controls				notes
		who? organization	when? sequence	by which? device,equip.	how? method	

2.2.5. Organizing questions of the I.Q.C.

Most of the I.Q.C. tasks are to be fulfilled by the production personnel: operators, foremen etc, except those checkings when laboratory device is required.

However there are critical points of the production line where the different working departments joint to each other, e.g. foil stock transfer, to the foil rolling line, or foil separating/rewinding machine to the final annealing or to the foil converting,where beside the plant I.Q.C. operation, the presence of the quality control organisation is essentially important.

2.2.6. Finished Product Quality Control /F.P.Q.C./

- Determining of the finished product:

A./ From point of view of a factory the finished product is that material, which receiving all the technological processes and convertings, finally quality checked and ready to sell.

B./ From point of view of a factory department the finished product is that material, which after the necessary technological processes, quality controlled and ready to transfer to the other department. /see para 2.2.5./ However these products are semi finished product for the factory.

- Purpose of the F.P.Q.C.

A./ To prove that the product quality corresponds to the requirements of the customer order and available for his application.

B./ To check that the product paramters meet the prescriptions of the home/international standards or factory standards.

C./ To check that the product quality covers the requirements of special application areas /e.g. food packaging/.

- Carry out the F.P.Q.C.

The final quality data/parameters are coming from three main sources.

A./ Collecting the necessary data from the I.Q.C.

B./ Quality characteristics can be established only on the finished product.

C./ Preparation of the quality control certificate.

2.3. Examples /See Technical Report/86 para H./

1. R.A.M.C. Foil stock 0,35 mm trimmed, rolling oil

Table No. 5.

No.	ERROR TROUBLE PARAMETER	CONTROLS ORGANIZ.	SEQUENCE	DEVICE, EQU.	METHOD	Notes
1.	Chemical comp.	quality cont.	each charge	spectrum an.	standard	
2.	Thickness, crown	quality cont.	each coil	micrometer balance	appl. formula	
3.	Width, weight					
4.	Mech. properties					
5.	Appearence					
	-Surface					
	-Trimming					
	-Winding					
	-Spool					
6.	Data sheet					
	For identification					
1.	Fresh oil certificat.					
2.	-"- labor chem.					
3.	Used oil: spec.					
	-Flash p.					
	-Viscosity					
	-Ash cont.					
	-IBP..FBP					
	-Acid no.					
	-Sapon. no.					

2. I.Q.C. Roughing and Finishing Mill

Table No. 6.

No.	ERROR TROUBLE PARAMETER	CONTROLS ORGANIZ.	SEQUENCE	DEVICE	METHOD	Notes
1.	Thickness, tolerances	plant personnel	continously each coil end	cont. thickn. meas. device, micro-cator	x-ray device sampling	
2.	Width					
3.	Weight					
4.	Flatness, shape					
5.	Surf.quality foil and roll					
6.	Winding					
7.	Edge					
8.	Pinhole					
9.	Spool					

3. F.P.Q.C. plain foil

1.	Width, weight	qual.cont.	each coil	micro-cator balance
2.	Thickness			
3.	Winding			
4.	Slitting			
5.	Pinhole no.			
6.	Surface quality			
7.	Mech. properties			
8.	Grain			
9.	Spool, core			
1o.	Outside diameter			
11.	Splicing			
12.	Windability			

C. Cold Mill

1. Basic technical data

- Roll sizes:
  - Work roll: ∅ 420x1930 mm /min. ∅ 380 mm/
  - Back up roll: ∅ 1120x1820 mm /min. ∅ 1040 mm/

Hardness:

- Work roll: 95-100 Sh "C"
- Back up roll: 70-80 Sh "C"

- Roll grinding:
  - Work roll: Grinding stone: 80
    Crown : 0,050-0.070 mm
    RMS : 20-24 r. passes
    Sampha : 16-18 f. passes
  - Support roll: Grinding stone: 46
    Crown : 0
    Sampha : 25x1 mm

- Mill speed: 0-540 m/min.
- Thread speed: 20 m/min.
- Max. entry g: 9 mm AL Alloy
- Max. exit g: 6 mm
- Min. exit g: 0,15 mm
- Max. strip width: 1670 mm
- Min. strip width: 810 mm
- Max. coil weight: 7250 kg
- Max. sep. force : 1550 ton
- Max. preload f: 1700 ton
- Core: ∅ 600x ∅ 640 x 1900 mm
- Payoff tension: Max. 22 ton, Min. 0,6 ton
- Rewind " Max. 17 ton, Min. 0,5 ton
- Oil circulation: Main pump: 3800 l/min
  Filter : 3800 l/min
- Filter efficiency: 0-5 microns
- Nozzles: Work r: 2x35
  Supp.r: 2x35

1.1. Existing technology /1230, 3003,/

No homogenizing

1. For foil stock: 1230, 1235, /1145, 1100/

1. 7,2 - 4 mm 44,4 %
2. 4 - 2,2 mm 45,0 % /Trimming/
3. 2,2 - 1,1 mm 50,0 %
4. 1,1 - 0,2 mm 40,0 %
- Anneal 400 °C 10 h
5. 0,7 - 0,35 mm 50,0 %

1. 7,2 - 4 mm 44,4 %
2. 4 - 2,2 mm 45,0 % /Trimming/
- Anneal 400 °C 10 h
3. 2,2 - 1,1 mm 50,0 %
4. 1,1 - 0,7 mm 40,0 %
- Anneal 400 °C 10 h
5. 0,7 - 0,35 mm 50,0 %

2. For disposable dishes: 3003

Homogenizing: Bell furnace

1. Heat up 595 °C 8 h
2. Holding 595 °C 8 h h.furnace
3. Cooling 295 °C 12 h

Charging into cold furnace

1. 7,2 - 4,5 mm 37 %
2. 4,5 - 3,0 mm 33 %
3. 3,0 - 1,7 mm 43,3 %
- Anneal 425 °C 10 h /12 h/
4. 1,7 - 1,0 mm 41 %
5. 1,0 - 0,6 mm 40 %
- Anneal 425 °C 10 h /12 h/
6. 0,6 - 0,35 mm 41,6 %

Homogenizing: Annealing f. charge: cold

1. Heat up	250 °C 1 h	350 °C 1 h	440 °C 1 h	
	535 °C 2 h	580 °C 1 h		
2. Holding	580 °C 9,5 h			
3. Cooling /heating off/		480 °C 1 h		
		380 °C 1 h	doors closed	
		280 °C 1 h		
		180 °C 1 h		
Heating on				
4. Holding	180 °C 2 h	take out		

3. Trimming:

- During 2nd pass
- After 0,7 mm pass, or after 0,35 mm ready pass.
  4th pass reduction 40 %

4. NOTES:

A./ Foil stock rolling 3 rd pass reduction 50 % looks too high

B./ 3003 4th pass after annealing is smaller reduction, than before?

C./ The second trimming is proposable not at 0,7 mm but 0,35 mm, just before starting the foil rolling.

2. Errors, problems, notes and proposals

2.1. Marking of the work rolls, materials

The error occured mainly on the bottom work roll drive side at finishing pass, strip is sharply cracked.

Possible reasons and proposals:

A./ Unequal pressure conditions between the work and support rolls /separating force/ due to some leakage or bad setting. Slipping of w. and s. rolls.

B./ Not enough pressure between the work and support rolls. Slipping between the work and support rolls.

C./ Slipping threads: due to bad spooling, loose coil.

D./ Emergency stop - roll slipping.

E./ Very small or extremly high reduction, slipping effect.

F./ Oxide in the material.

G./ Rolling oil lubricity is not enough inner bottom w.roll is always warmer.

H./ Bad operation with reversing pressure

Summerizing: The error possibly born on serious mechanical damage, between roll and strip surface, or strip/strip surface. It is proposable to eliminate it on the following way:

1./ Checking the hidraulic system leaking.
Measuring the pressures on both sides of the preload system.

2./ To make an interlock to prevent the bad operation with the reversing pressure.

3./ In case of a break an automatic system is proposable to set the separating system for the maximum.

4./ Establishment of the minimal separating force or pressure would be necessary. An interlock do not let the mill turning under this pressure, if the roll gap is empty.

5./ Small or very big reduction and not enough separating force is to be avoided.

6./ Reducing the crown of the work rolls - in case of continous operation - helps to reduce the reversing pressure as far as the minimum.

7./ Rolling oil conditions should be kept on the level of the GEMREX 57 base oil.

8./ Metal cleaning process is to be improved to avoid the roll surface damages caused by the non-metallic inclosures, oxides etc.

2.2. Errors of the casted strip

2.2.1. Sticky holes, metal flow brakes mainly in the middle part.
Proposal: See A/4.4.1.

2.2.2. Non metallic inclosures, impurities gas residuals
Proposal: See A/4.1., 4.2.

2.2.3. Surface quality:
Marble marked surface, shell conditions.
Proposal: Improving shell cooling conditions, repairing cover shell surface or change.

2.2.4. Crown of the casted strip

Inner part of the casted strip always heavier.

Proposal: See A/4.4.5.

2.3. Pass schedule optimization.

2.3.1. Foil stock, Alloy 1230.

Proposal: After casting - homogenizing.

Pass	Thickness /mm/	Reduction /%/	Note
1.	7,2 - 4	44,4	
2.	4 - 2,15	46,5	Trimming
3.	2,15 - 1,2	44,2	
4.	1,2 - 0,7	41,6	
Anneal	425 °C 10 h		
5.	0,7 - 0,35	50,0	
6.	0,35	-	Trimming

2.3.2. Foil stock Alloy 3003, Homogenized

Pass	Thickness /mm/	Reduction /%/	Note
1.	7,2 - 4,4	38,8	
2.	4,4 - 2,5	43,18	Trimming
3.	2,5 - 1,45	42,0	
4.	1,45 - 0,9	37,93	
5.	0,9 - 0,6	33,3	
Anneal	425 °C 10 h		
6.	0,6 - 0,35	41,6	
7.	0,35	-	Trimming

Because of the homogenizing one intermediate annealing is sufficient.

2.4. Operational errors

2.4.1. Flatness shape problems.

Specially in case of the wider materials /1500 mm, 1360 mm/ the flatness is not correct. Wavy, overroled surface is typical at first and second pass.

Proposals:

- Decrease the rolling oil temperature.
- Increase the oil pressure if possible.
- More flexible operation of the cooling zones.
- Checking the angularity of the sprays.
- Decrease the rolling speed, in case of overheating.
- Decrease the crown of the casted sheet.
- Checking the conicity of work and support rolls.
- Correct arrangement of the rolls when change.
- Checking the shape and symmetry of the crown of the rolls.

2.4.2. Threading operation.

Applying the belt wrapper, after the starting several threads, the rewind tension released, later increased. The core of the coil is incorrect.

Proposal: Keeping the rewind tension on a suitable level, tight core is to be produced at the beginning of the rolls.

2.4.3. Oil eliminator air blow.

The eliminator air blow is put on too late, beginning of the coil is oily. Annealing problems can occure.

Proposal: After setting the rolling oil on to the sprays, the air blow should be put on immediately.

2.4.4. Rolling oil quality

The surface of the rolled web is stripped, oil film is not continous. Oil quality is not quite correct. In case of the higher temperature conditions there is a danger of fire, because of the low flash point.

Proposals:

- Decrease the oil temperature.
- Checking the additive concentration, if the annealing properties are ok - increase the additive concentration.
- Improve the base oil quality following the GENREX 57 rolling base oil parameters.

D. Experimental running on the Caster Line

1. The main goal of the experiment, precedents:

In accordance with the earlier discussions with the officials of UNIDO CENTER VIENNA I gave advises about special raw and aid materials /including qualities, quantities and suppliers/ available for metal cleaning, degasing and grain refining of the casted strip.

Supported by UNIDO CENTER the following raw and aid materials were provided for ALUMPAS company in the third week of my mission:

- Hexachlor ethane: ELIDRON 160/100 175 kg
  Supplier: CESANA, ITALY
  Form: Tablet, 25 kg/box
- Titanium Boron Master Alloy: 80 kg
  Supplier: KAWECKI BILLITON, Holland
  Form: Billet, 7 kg/billet

Applying the above materials a trial was planned to elaborate an improved technology for metal cleaning, degasing and grain rafining processes, obtaining a better quality of the casted strip.

2. Preparation of the experiment

Taking the form of the raw and aid materials into consideration, double quantity is required from hexachlor ethane in tablet form as in powder form and the same for titanium boron: from billet double quantity is needed as from the rod form. In agreement with plant management the whole operation was concentrated on the holding furnace to spare materials.

2.1. Theoretical and initial figures

- Alloy selected: 1230, no scrap added into the melting furnace, for foil stock. Initial Ti content: 0,01 %

- Hexachlor ethane:

Tablet form is to be charged, in holding furnace:
4 kg/ton metal
That means: 40 kg/10 ton charge

Titanium Boron in the holding furnace:
Billet /block/ form is to be charged, in holding furnace: 2 kg/ton metal, supposingly the master alloy is for 5 Ti/1 BORON rate. As the capacity of holding furnace is 10 tons, that means: 20 tons/10 tons charge, practically 3 blocks: 21 kg.

Ti increase:
1 kg TIBOR/1 ton metal : 0,005 %
7 kg TIBOR/10 ton charge: 0,0035 %
14 kg TIBOR/10 ton charge: 0,007 %
21 kg TIBOR/10 ton charge: 0,011 %
28 kg TIBOR/10 ton charge: 0,014 %

2.2. Experimental run No. 1.

2.2.1. Process in holding furnace:

- Dedrossing
- Charging 12,5 kg Hexachlorethane
- Mixing by Nitrogen 10 min.
- 7 kg TIBOR added, hand mixing
- COVERFLUX: 4 kg added
- Draining from melting furnace
- Charging 12,5 kg Hexachlor ethane
- Mixing by Nitrogen
- 7 kg TIBOR added in launder of melting furnace
- Mixing by Nitrogen and hand.

2.2.2. Process in caster

	bottom top
- Input water temp.	24-24 °C
- Input water pressure	3 atm
- Output water pressure	0,5-0,8 atm
- Holding furnace temp.	730 °C
- Head box temp.	685 °C
- Preload pressure	350 atm
- Casting speed	1,05 m/min
- Caster arm.	17 A
- Rewind	1 A
- Thickness	6,9 mm
- Width	1300 mm
- Crown	0,2 mm

2.2.3. Results:

The Ti content varied between 0,038-0,070 %
The grain sizes of samples: mostly coars, very coars, medium. Increasing the TIBOR the fine grain appeared occasionally, but not on both sides and not in full width.

2.3. Experimental run No. 2.

Practically the same way as 2.2. but the TIBOR is added in half blocks /3,5 kg/through both doors of the holding furnace of the same time.
Ti content varied between 0,038-0,055 %
grain sizes: middle, coarse, very coars, occasionally fine on one side /bottom/.

2.4. Experimental run No. 3.

2.4.1. Holding furnace

- Drain melting furnace Ti: 0,01 %
- Hexachlor ethane: 12,5 kg added
- Mixing by Nitrogen 10 min
- TIBOR added: 21 kg through both doors at the same time in 3,5 kg half blocks quickly
- Intensive mixing by Nitrogen and hand.
- Ti content: 0,04 %
- TIBOR added: 7 kg : Ti: 0,045 % mixing

2.4.2. Casting parameters:

- Temperature in the holding furnace: 750 °C
- Head box temperature: 700 °C
- Casting speed: 1 m/min
- Caster amp.: 20 A
- Preload press.: 320 atm
- Rewind amp.: 1 A
- Water inlet temp.: 25-25 °C
- Water inlet pressure: 3 atm
- Water outlet pressure: 0,7-0,7 atm

- Process continued by draining 4 tons from the melting furnace
- 12,5 kg Hexachlor ethane added
- 14 kg TIBOR added
- Mixing by hand and Nitrogen
- Ti content: 0,035 %

2.4.3. Results:

Grain size: Immediately after the TIBOR addition corresponded the theoretical figure: 2 kg/1 ton charge, 20-21 kg/10 ton metal, applying the sufficient mixing the fine grain was obtained on both sides of the casted strip. Most of the samples were fine both sides, rarely one side medium, other side fine. During this run coarse grain was not observed. The good quality strip produced at least 20 tons.

3. Evaluation, proposals:

3.1. Metal cleaning, degasing:

Applying perforated basket for the immersion of the Hexachlor ethane tablets intensive bubbling and metal bath motion can be observed. The above operation is followed by Nitrogen gas introduction and mixing by the Nitrogen pipe. Meanwhile significant fume generated.
Based on the outside appearences and the good dross generation can be stated that the process able to produce an effective metal cleaning and degasing result.Unfortunately suitable measuring devices are not available to establish the actual figures of inclosures and Nitrogen residuals. Necessary to note that the hexachlor ethane charge applied was under the theoretical figures and used only in the holding furnace.

3.2. Proposals on the metal cleaning, degasing

3.2.1. Metal cleannes, Hidrogen content:

As the plant has no suitable devices, is proposable to send the samples for further checking to the institute concerned. Simultaneously suggested to provide the necessary devices to keep the metal treatment under continous control. Depending on the checking results the quality of the cleaning media can be taken into consideration.

3.2.2. Improvement of the metal cleaning, degasing

To improve the efficiancy of the process, and to decrease the production costs is advisable to apply the hexachlor ethane in pawder form introduced by the Nitrogen injector explained in the para IV.A 4.2.1. Necessary to note that the quantity required in pawder form is exactly the half that of the tablet.

3.2.3. Further rolling of the experimental colls

After suitable homogenization of the casted strips cold rolling as far as 0,7 mm, intermediate annealing, and final rolling of the foil stock as far as 0,35 mm is proposable. After trimming the coils are to be rolled as far as 9 micron. Pinhole numbers are indicating the efficiancy of the metal cleaning: above 200 pinhole/m^2 the cleaning is not sufficiant, between 100-200 pinhole/m^2 the cleaning is acceptable, under 100 pinhole/m^2 the cleaning is good.

3.2.4. Exhaus .ng system

The efficiancy of the existing system is not suitable. To obtain better working conditions reasonable sized hood and vetillator is to be provided above the furneces, operated during the high fume generating degasing prodess.

3.3. Grain refining:

3.3.1. Quantity of TIBOR

The experimental results prooved, that under the theoretical limit of 2 kg/1 ton metal, fine grain structure is not obtainable, if the TIBOR is charged in billet /block/ form. Taking the 10 tons capacity of the holding furnace into consideration the proposable quantity is 25-35 kg/10 ton metal.

3.3.2. Quality of TIBOR

In accordance with the international experiances 5 Ti/1 BORON master alloy is proposable. If TIBOR is available in rod form, this is preferred.

3.3.3. Form and charging method

To obtain the best efficiancy of grain refining and reducing the master alloy costs significantly the rod form is to be applied through rod feeder device. /See IV. A 4.2.4, and 4.3.2./.

E. Experimental running on the Cold Mill

1. Application of the optimized pass schedule and homogenization

Simultaneously with the experiments on the caster line test rolling was organized to check the proposed pass schedule and homogenization technology.

Four coils produced by the traditional casting technology /without grain refinement/ were started to experimental rolling applying the proposed pass schedule C./2.3.

Coil No: E1, E2, E3, E4
Alloy: 1235
Width: 1360 mm
Thickness: 6,67, 6,82, 6,5, 6,62 mm
Crown: 0,13, 0,1, 0,08, mm
Grain: Very coars all of them.

E1 and E2 coils were homogenized on the following conditions:
1. Put coils into the furnace at 400 °C
2. Heat up as far as 520 °C for
3. Holding 520 °C 8 hours
4. Cool down as far as 300 °C during 10 hours
5. Discharge the coils.

Data sheet was prepared, handed over 1st and 2nd passes are completed, parameters are registered. It was not possible to complete the run during my staying in ALUMPARS, because my mission came to an end.

Proposal:

Complete all the passes, registering the parameters, then evaluate the rollability and mechanical properties. Suggested to continue the rolling on foil rolling line as far as 9 micron.

2. Test rolling of the grain refined coils following the technology of para E/1.

Appr. 20 tons casted strip produced by the experimental run on the Caster Line with TIBOR grain refining and Hexachlor ethane cleaning, degasing are proposable to homogenize, cold rolling by the suggested optimized, pass schedule, then further rolling as far as 9 micron. Evaluation and conclusions can be drawn on the following items:

- Rollability, formability, influence of the fine grain
- Mechanical properties
- Pinhole number on 9 micron gauge.

F. Foil rolling

During my mission there was no possibility for observation of the foil rolling activity. By the occasion of the classes consultation was taken place with rolling personnel about the following questions:

1. Threading system on double pay off
2. Mill center line setting
3. Foil mills rewind side modification, setting guide roller
4. Effect of separeting-reversing pressure on shape control
5. Elimination of center cutting of foils
6. Creasing effect under the ironing roller
7. Different rollability of the coils
8. Rolling oil qualities, comparison of different oils
9. Effect of work roll diameter on the reduction and mill drive
10. Typical alloys for foils and dishes
11. Developing tendencies in foil rolling
12. Cold starting conditions
13. Crowning system
14. Crowns and different width connections
15. Grain refining and iron content
16. Back up roll crowning.

The questions were answered, explained and the most important ones were underlined in the RECOMMENDATIONS para D.

G. Converting line

One and a half day consultation was held on the following areas of the converting and slitting departments:

1. Errors of the plain foil from foil rolling

- Grisy, oily surface
- Shape, flatness is not correct, wavy surface
- Oil stain, water stain
- Burnt oil spots
- Sticky coils, difficult to decoil
- Smell

Proposals to improve the quality:

1.1. Checking the additive concentration water cont. ash content, saponification No., viscosity, final boiling point of the rolling oil. Keep the oil in perfect quality.

1.2. Applying active filter materials in fine filtration system.

1.3. Covering, plating the work and support rolls on rewind side to prevent the rolling oil spraying and contamination on foil surface.

1.4. Discovering the oil condensation on rewind side, elimination of dripping of the oil onto the foil surface.

1.5. Correct setting of the oil eliminator air blow pipe. Compressed air must be free of water.

1.6. Checking the coil density measuring the length, weight, applying the following formula:

$$\gamma = \frac{W}{B.L.T.} = \frac{/kg/}{/dm/\ /dm/\ /dm/} = \frac{kg}{dm^3}$$

W: weight /kg/
L: length /dm/
T: thickness /dm/
B: width /dm/

for thickness: 1/mm = 10^{-5} dm

γ = density $/\frac{kg}{dm^3}/$

The proposable coil densities:

9 /u foil: = 2,3 - 2,35
above 9 /u foil: = 2,4 - 2,5

1.7. Flexible final annealing technology in accordance with the Final Boiling Point of the rolling oil, proposable temperature:

$$T = FBP + 60\ ^{\circ}C$$

1.8. Improvement of the shape:

- Correct crowning system.
- Shape control by means of preload pressure, oil sprays, and oil temperature.
- Minimal pay off and rewind tensions.
  Details see technical report/85. P.30-33.
- Guide roller is to be built on the rewind side.

2. Wet lamination:

2.1. Adhesives, generally applied, and are advisable

- PVAC water dispersion - STRUCOL
- CASEIN LATEX water dispersion - CASCOSEL DR 29
  Suppliers: See ANNEXES
  PVAC has low heat resistance
  CASCOSEL has good heat resistance up to 180 °C
- IRANIAN PVAC material: Looks too thin, water content is high, bonding strenth is low. 24 sec F4 is low for viscosity. Try to obtain a more concentrated sample, around 1 min, and gradually adding the water as far as possible, around 40 sec F4 bonding would be better. Coating weight of 1,5-2 g/m^2 is enough /in dry/ Drying temperature: around 100-120 °C depending on the speed.

3. Dry lamination:

3.1. Proposable plastic films for dry lamination

- CELLOPHANE : 20-40 micron
- BOPP : 20-40 "
- LDPE : 30-100 "
- PES : 12-20 "
- POLYAMID : 20-40 "
- PVAC : 20-40 "

3.2. Surface activity, CORONA treatment

The plastic film is to be laminated has to have a reasonable surface activity, measurable by special checking ink or pen, expressed in DYN/CM dimension. This activity is changing in time and will be reduced, depending on the quality of the film. This process is significant at BOPP, but specially at LDPE films. The original surface treatment is provided by the supplier Co.

The surface activity value required by the good lamination is at least 38 DYN/CM. For this reason - specially at LDPE and BOPP films - before lamination an in line CORONA treatment is suggested to renew the surface activity.

3.3. Dry laminating adhesives proposable:

- For food packaging materials:
  Sterilizable at 121 °C 30 min.
  LIOPOL UK 3640 Basic component
  HARTER UK 6800 Hardener

- For industrial laminates only:
  High heat resistance up to 260 °C
  LIOPOL UK 3645 Basic component
  HARTER UK 6200- Hardener

Attention: Not available for food Packaging laminates!

Supplier: HENKEL KGAA, Düsseldorf G.F.R.

Detailed technical description and application sheets were handed over in copy.

NOTES: After lamination at least 48 hours are required for polymerization of the adhesive before the next operation starts.

From the lamination till the application at the customer at least two weeks are necessary to obtain perfect bonding.

3.4. Heat sealable lacquers

- Components:

VMCH resin - Union Carbide
VYHH resin - Union Carbide
PLEXIGUM P 29 resin - Polyvinyl Chemie
CITROFLEX softener

- Typical application fields:

A./ Cheese wrapping foil, Coating: 4 g/m^2 /DRY/ seeling to itself.

B./ Heat sealable lids. Coating: 4-6 g/m^2 /DRY/ sealable to Polystyrene and PVC.

- Typical heat sealing temperature range:

150 - 180 °C depending on the speed of the packaging machine.

3.5. Combined packaging material examples:

A./ Milled cofee packaging material:

- Print 2 g/m^2
- BOPP 20-30 µ $\sqrt{}$ both sides surface treated
- Adhesive 2 g/m^2
- Alufoil 12 µ
- LDPE 40-60 µ

B./ Fruit juice packaging material:

- BOPP 30 µ 1.side surface treated, 2.side PVDC coated
- Adhesive 2 g/m^2
- Print 2 g/m^2
- Alufoil 12 µ
- LDPE 100 µ

C./ TETRAPACK aseptic packaging material:

- LDPE 10-15 g/m^2
- Paper 150 g/m^2
- LDPE 8-10 g/m^2
- Alufoil 7-9 µ
- LDPE 50-60 g/m^2

4. Slitting

4.1. Slitting errors:

Slitting of 30 µ Alufoil
30 g/m^2 PE — combined foil

total: 110 g/m^2

Appearence: The slitted edge of the coil is wavy, and rimmed up.

Possible reasons, proposals:

A./ The edge of the male or female knife is weared

B./ The diameter of the male knife is not equal

C./ The immersion of the male knifes is too deep.

D./ The ironing pressure is not enough

E./ The angularity of male knife is not corresponds to the given laminate

F./ PE film thickness is not equal along the width of the laminate, the coil diameters slitted are not the same.

Angularity of knife presently: 15° suggested to increase as far as 30-45°, based on experiences for different materials. Heavy ALU+PE laminates are able to slit with 90° angularity too.

Spacer beside the female knife can be grinded by small radius.

Slitting knife grinding machine:

For the moment is out of use. The machine is to put into operation for regrinding the weared knifes and for setting the correct angularity of the different materials are to be slitted.

M. Proposals of the requirements on the different areas of the activities of the Aluminium Pars Co.

1. Materials:

1.1. Plastic films for laminating to alufoil:

- LDPE /low density polyaethylene/ and BOPP /biorientated polypropylene/ films, surface treated.

1.2. Metal treating raw and aid materials:

- TITANIUM BORIDE /5/1 rate of Ti/B / in rod or-block /ingot/ form for grain refining.

Purchasing source: Directly: KAWECKI-BILLITON, Holland

- HEXACHLOR ETHANE in tablet or powder form.

Purchasing sources: Directly: SERVIMETAL Co. France
ERICH BARTH Co. Austria
POSECO Co. Austria

1.3. Laminated aluminium foil combinations, ready for printing:

- ALUFOIL + PAPER — MAX. width: 1200 mm
- ALUFOIL + PE — MAX. weight: 300 g/m^2
- BOPP - ALUFOIL - PE
- ALUFOIL - BOPP
- PAPER - ALUFOIL - PE
- ALUFOIL - PAPER - HOT MELT
- PAPER - ALUFOIL - heat sealable lacquer
- ALUFOIL - heat sealable lacquer
- ALUFOIL - Parchment wax laminated

Purchasing source: HUNGARY, ALUKER Co.

1.4. Active filter material

TYPE: TONSIL LFF 80 /See technical report/86. P.24./

1.5. Grinding stones, /See techn.report/86. P.20. and 54./

Grain: 120, 150, 220, Hardness: K
" 320, Hardness: K

2. Equipments, devices

2.1. Automatic strip braker for foil mills

Purchasing source: NEW HUNTER Co. Italy

L.M.V. S.R.L, Strada S. Eusebio 24, Italy
Phone: /0124/ 26926-7-8, Telex: 215165 LMVI
Mr. M. Capozzielli, President; Mr. Andreazza

2.2. Meter caunter for foil separators

P.S. : NEW HUNTER - Italy
L.M.V. - Italy
Technoimpex - Hungary

2.3. Nitrogen injector for powder, for metal cleaning, degasing.

P.S.: HUNGARY - ALUKER Co.

2.4. Roll crown measuring and registering device

P.S.: SCHOPPE and PAESER - G.F.R.
HOMMEL WERKE - G.F.R.
/Technical Report/86, Page 54./

2.5. Measuring device for hidrogen gas concentration

2.6. Measuring device for non-metallic inclosures, impurities

2.7. Mechanical thickness measuring devices for thin foils

P.S.: HUNGARY - MIGÉRT Co.

2.8. Automatic Temperature Control for foil mills rolling oil systems

P.S.: NEW HUNTER - Italy
Technoimpex - Hungary

2.9. Automatic Gap Control System for cold mill

P.S.: NEW HUNTER - Italy
DAVY MCKEE - England
Wallisdown Road, POOLE DORSET BH 125AG
Phone: /0202/ 512211, Telex: 41211
Mr. J. Wadham area Sales Manager
Mr. T. Smith rolling mill senior eng.

2.10. Automatic Shape Control System for cold mill

P.S.: NEW HUNTER - Italy
DAVY MCKEE - England
MEASUREX INTERNATIONAL
Gottfried-Kaller-Gasse 2/15-16 A-1030 Wien,
Phone: 0222/7578430, Telex: 116929
Mr. H. Pummer Regional Manager

2.11. Extension of the Automatic Thickness Control on pay of tension as well on foil mills

P.S.: NEW HUNTER - Italy

2.12. Metal Surface Temperature Measuring Device for casters

P.S.: MIGÉRT Co. - Hungary

2.13. CORONA TREATING DEVICE /1pc/ for dry laminating machine

P.S.: NEW HUNTER - Italy
L.M.V. - Italy
CROSSFIELD - England

2.14. Guide roller on rewind side on foil mills

Techn. Rep./86

P.S.: NEW HUNTER - Italy

2.15. Gap measuring checking device on extruder

- Video operated equipment indicating the shape of the extruded film by zones.

3. Know how, Education, Technical Assistance

3.1. Know how of the direct process, to manufacture Aluminium Pigment products /flakes, pastes and ready paints/ from aluminium foil scraps.

P.S.: ALUKER - Hungary

3.2. Scholarship for 5 Iranian youngsters/year who passed the final examination at a secondary school, offered by the Hungarian Government.

3.3. Further practical and theoretical education of Iranian technical people, in Hungary, including skilled workers, technicians, and engineers, based on the Technical and Scientfic Cooperation Contract between Iran and Hungary.

3.4. Maintening the UNIDO adviser activity in ALUMPARS company, concentrated on foil rolling and converting lines, and the production lines of the foil stock.

V. UTILIZATION OF RESULTS OF THE ACTIVITY

A. Areas and way of the utilization of results

1. Caster line

1.1. Melting furnace:

- The application of the scrapless metal raw material was accepted, when producing foil stocks.

- Modification of the alloying system is under way. Instead of grinding and spraying of the master alloys the application of the perforated steel basket is preferred.

- For the improving the metal cleaning and degasing system the installation of salt powder injector was taken into consideration. Measures were taken to provide an offer a[illegible] the equipment for Aluminium Pars Co.

1.2. Holding furnace:

- The advantages of the application of the hexachlorethan was prooved in the practice for metal cleaning and degasing during the experimental run.

- The introduction of the above salt powder injector in the holding furnace technology was decided as well.

- The modification of the exhausting system above the melting and holding furnace was decided.

- The necessity of the introduction of the continous checking of the hydrogen gas concentration and the non-metallic inclosures in the metal, was accepted.

- Based on the discovering of the mistaken setting of the rod feeder, my proposal about the correct setting was accepted, and immediate measures were taken for the modification.

1.3. Caster

- Applying the proposed metal cleaning, degasing and grain rafining materials and technology, successful experimental run was carried out on the caster line producing casted strips with fine grain of appr. 20 tons.

- Proposal for the modification of the cooling water supply of the caster, was accepted, measures were taken to put the water softening system into operation.

- Proposals for the improvement the shape and surface quality of the casted strips are taken into consideration.

2. Quality Control System

The further development of the Q.C.S. is basically agreed on the three main areas, personnel conditions, equipments, devices are going to be provided.

3. Cold mill

3.1. Homogenizing of the casted strips

Homogenizing of the casted strips for foil stocks was accepted, the proposed experimental technology was started to apply.

3.2. Pass schedule optimization

The proposed modification of the pass schedule for Alloy 1230 foil stock and Alloy 3003 materials was accepted, taking the above homogenizing technology into consideration. Application of the modified technology was started.

3.3. Operational errors, equipment foilures

The findings and discovered possible reasons were understood. Part of the problems can be solved by organization part of them need some modification on the machine or providing some equipments, devices are to be attached to the present ones.

4. Foil rolling and converting lines

4.1. Foil rolling

Based on the last year experiances useful consultation were taken place with rolling personnel to improve their theoretical and practical knowledge. The necessary modifications of the foil mills were established and underlined.

4.2. Foil converting

- Errors of the plain foils are to be converted were discovered proposals were given to improve the quality.

- Wet lamination: proposals were elaborated, to improve the quality of the home made adhesive.

- Dry lamination: Technical conditions of the process were clcared, detailed technical information was handed over about dry laminating adhesives and technology.

- Slitting: Proposals were elaborated to improve the slitting conditions and the regrinding of the slitting knives.

B. Technical developing questions

Studying the realistic requirements of the Aluminium Pars Co. to increase the technical level, the quality of the products and generally the efficiancy of the production the following proposals were elaborated /Detailed in the Chapter "INTRODUCTION" para G. and IV/ H./

1. Follow up programme supported by UNIDO

- Extension of the UNIDO experts activities on the whole production areas of the company including a new area as well, the production of aluminium pigment products.

- Organizing a wide ranged training activity
- Providing necessary equipments and devices
- The estimated costs of the project:

Experts	210000 USD
Training	116500 USD
Subcontract-pigment	100000 USD
Equipments	737500 USD
Miscellaneous	20000 USD
Project total:	1184000 USD

2. Raw and aid materials

- Plastic films for laminating to alufoils
- Metal cleaning, degasing and grain rafining materials
- Laminated aluminium foil combinations
- Filter aid materials
- Grinding stones

3. Equipments, devices

In addition to the devices included in the UNIDC supported follow up programme, the equipments given below are necessary:

- Injector for metal cleaning degasing powders
- Automatic Gap Control System for cold mill
- Automatic Shape Control System for cold mill
- Extension of the Automatic Thickness Control System on the foil mills
- CORONA treating device for dry laminating machine
- Guide roller on the rewind side of the foil mills.

4. Education

- Scholarship for 5 Iranian students/year offered by the Hungarian Government
- Further education of Iranian technical people in Hungary.

VI. CONCLUSIONS

1. During the mission the existing machinery the technology applied, the quality of the products and the skillfulness of the personnel were detaily investigated on the caster department and cold mill areas.

2. Applying the metal cleaning, degasing and grain rafining materials provided by UNIDO CENTER VIENNA and proposed technology successful experiment was carried out producing good quality casted strip with fine grain.

3. Experimental run was started on cold mill line applying homogenizing technology for the casted strip and improved pass schedule.

4. Proposals were elaborated on caster an cold mill lines to improve the technology, working conditions, quality of the products and the machinery.

5. Consultations were held on technological, operational, theoretical and practical questions of foil rolling and converting lines.

6. Detailed proposals were elaborated for further development of the Quality Control System.

7. In accordance with the requirements of plant management classes were delivered in 24 hours on the caster, cold mill, quality control and foil rolling areas.

8. The requirements of Aluminium Pars Co. were seriously studied to improve the efficiancy of the production on the areas concerned and detailed proposals were elaborated about a UNIDO supported developing programme, the necessy machinery, devices, materials and education.

VII. ANNEXES

A. Counterpart staff

1. United Nations Development Programme, Tehran Office

- Mr. Raj Kumar Dar - Resident Representative
- Mr. M.V.D. Schulenburg - Vice Resident Representative
- Mr. Ghaffarzadeh - Programme Officer
- Mr. J. Singh - Chief, General Services

2. Aluminium Pars Co., Head Office

- Mr. Mazinani - member of directory board
- Mr. Abrishami - member of directory board
- Mr. Amiri - commercial director

3. Aluminium Pars Co., Plant management

- Mr. Roumiani - plant manager
- Mr. Aliabady - production manager
- Mr. Rezai Nouri - planning, programming manager
- Mr. Mir Ghaazemi - Chief Cold Mill and Foil Rolling Line
- Mr. Dourguly - Chief Quality Control
- Mr. Sakhiyan - Chief Foil Converting Line
- Mr. Saffaarnia - Chief Sheet Finishing dpt.

4. Hungarian Embassy:

- Mr. Zs. Kázmér ambassador
- Mr. J. Nagy commercial counsellor
- Mr. B. Nagy secretary

B. Important adresses

1. Aluminium Pars Co.

Head Office:
Africa Ave, West Parzan st. No. 65.
TEHRAN, IRAN
Phone: 229011-5
Telex: 213056 Poil IR

Plant:
SAVEH INDUSTRIAL CITY
SAVEH

2. Embassy of the Hungarian People's Republic

Shahid, Khaled Estamboli Ave
13th Street No. 18.
TEHRAN, IRAN
Phone: 662-800

3. Commercial Section of Embassy of the Hungarian People's Republic

Mailing adress: P.O. Box 8651 TEHRAN
IRAN

Street adress: Ave Mirzaye Shirazi
17th Street No. 41.
TEHRAN, IRAN

Phone: 824-048 /Central/
Telex: 213864 HUEX IR
Phone Counsellor: 831-234

4. Suppliers of foil converting materials

4.1. Water based adhesives

- UNILEVER EXPORT B.V.
  P.O. BOX 105
  3000 AC ROTTERDAM, HOLLAND
  Phone: 010-644656
  Telex: 24287
  Ref: Mr. A.B. van Dijk

- CECA S.A.
  12/16 allée des Vosges
  La Défense 5. Cédex 54-92062
  Paris - La Défense - France
  Phone: /1/ 49041234
  Telex: CECAS 611444 F
  Ref.: Mr. P. Lacour

- LONDON CHEMICAL CO. LTD.
  121 KINGSWAY London WC 26 PO

4.2. Printing inks

- CIBA-GEIGY AG.
  CH-4002 BASEL
  DIVISION KA 6.22
  Phone: 061/376343
  Telex: 62355
  Ref.: Mr. G. Herres

- POLYVINYL CHEMIE
  Wien, Schwarzenbergplatz 7.
  A-1030 Wien
  Phone: 0222/7266152 501-2
  Telex: 135260 PCH A
  Ref.: ing. H. Mikowitsch

- HOECHST AKTIENGESELL SCHAFT

6230 Frankfurt am Main 80
Phone: /069/ 305-7033
Telex: 225975 Inhol h
Ref.: Mr. P.D. Behl

4.3. Thermoplastic resins

- UNION CARBIDE U.K. LIMITED

Union Carbide House, High street
Rickmansworth, Herts, WD31RB
Phone: /0923/ 720366
Telex: 262472

Budapest, September 1987.

István ACSÁDY