T1

Maintenance & Engineering

TAP environmental defence processing

an exploration of history, challenges, successes and future

Ana Paula Matos, Ana Ricardo, Filipe Alves & Vítor Morgado Gonçalves

T1 This presentation is the contribute of TAP - Maintenance and Engineering Business Unit

TAP, 9/17/2004

Summary

- historical overview
- wastewaters
- gas emissions
- industrial wastes
- environmental management system
- C3P 2004 strategic project plan

T2

The presentation is organized by areas of concern regarding Health and Environmental issues as well as projects for environmental management systems and pollution prevention.

Within each area of concern, research, development and results, this is all data, are presented chronologically.

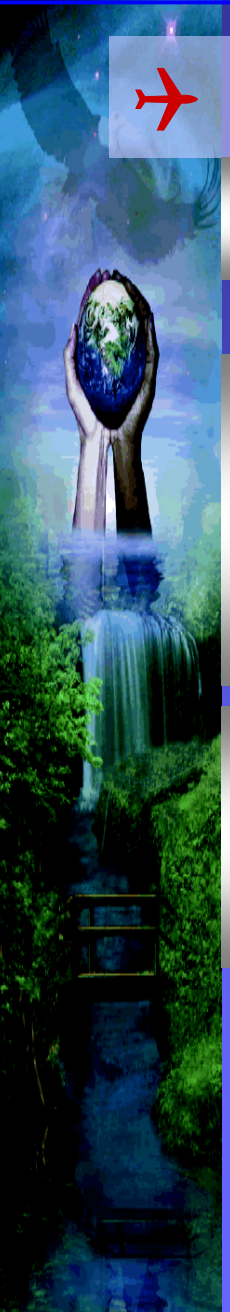
The first issue to be presented afterwards is an historical overview, conceived as a synopsis.

The next three issues are the three main lines of concern of TAP/ME, during the last 17 years and

The last 2 issues, being the first 'ENVIRONMENTAL MANAGEMENT SYSTEM' was embraced by TAP with the aim of ISO 14001 certification.

The last, but not the least, is 'NASA/C3P Strategic Project Plan' with TAP/ME commitment for 4 (of 6) alternative programs regarding Polution Prevention and Occupational Risks.

TAP, 9/17/2004



Historical Overview

- **wastewaters**

- **1987**

  TAP/ME **worried** with cyanide stripper, started to study its behaviour and how to develop a WWTP for this bath

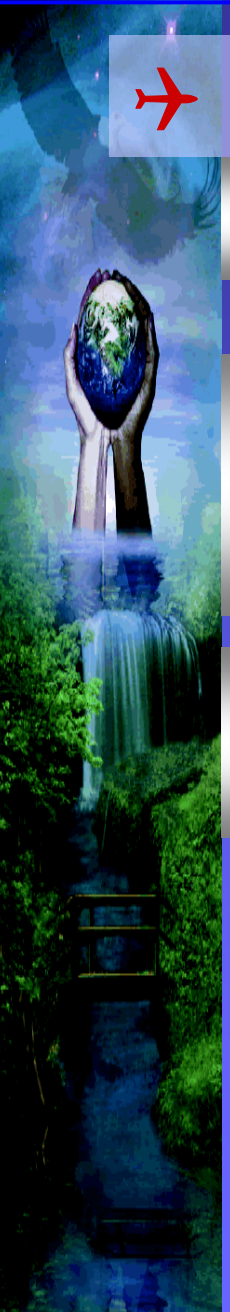
- **1988**

  TAP/ME **acquired** a WWTP for all plating shop wastewaters

T3

Regarding, WASTEWATERS,
The process of metals removal using cyanide stripping solutions, created highly pollutant WASTEWATERS.
Since 1987 TAP/ME worried with this problem, started to study the behaviour of the bath and how to develop a WASTEWATER Treatment Plant.
In 1988, TAP/ME acquired a WASTEWATER Treatment Plant for all plating shop WASTEWATERS.

TAP, 9/19/2004



Historical Overview ...

- wastewaters ...

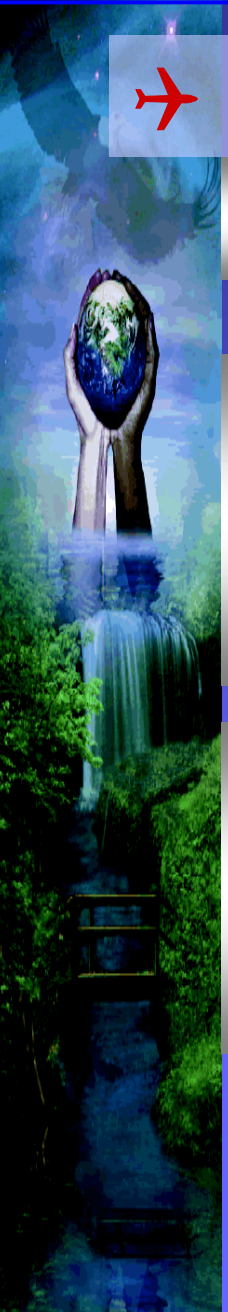
- 1998

  TAP/ME designed a new plating shop and a dedicated WWTP

- 2001

  TAP/ME started up this new complex

T5 Furthermore,
During 1998, a new plating shop and a dedicated WASTEWATER Treatment Plant were planned,
and finally
In 2001, this new complex started up as a TAP/ME facility.
TAP, 9/19/2004



Historical Overview ...

- gas emissions

  - 1999/2000

    TAP/ME **acquired**, for the engine cleaning shop, a completely renewed cleaning bath exhaust system and a scrubbing system

  - 2001

    TAP/ME **installed** a scrubbing system for the adequate treatment of all gas emissions, together with the new plating shop

T6 Concerning GAS Emission,

During 1999/2000, TAP/ME acquired, for the Engine Cleaning Shop, a completely renewed cleaning bath exhaust system and a scrubbing system
and
In 2001, together with the new plating shop facility, a scrubbing system for the adequate treatment of all gas emissions, was installed.
TAP, 9/19/2004

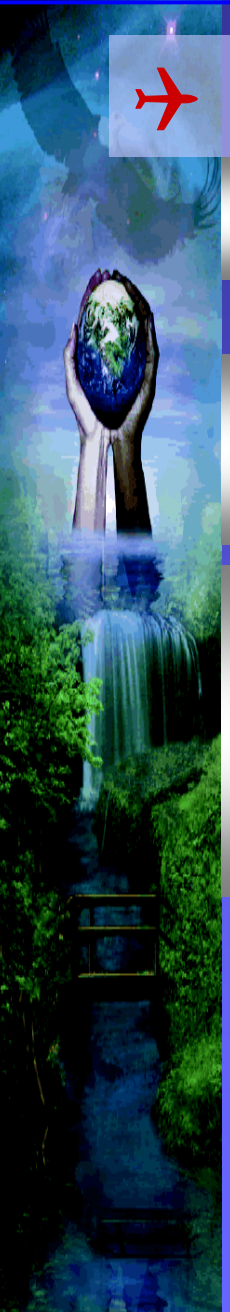
Historical Overview ...

- gas emissions ...
  - 2004

    TAP prepared all steam and hot water boilers to work with natural gas

T7 Additionally,

In 2004, all steam and hot water boilers were prepared to work with natural gas.
TAP, 9/19/2004



Historical Overview ...

- industrial wastes
  - 1997

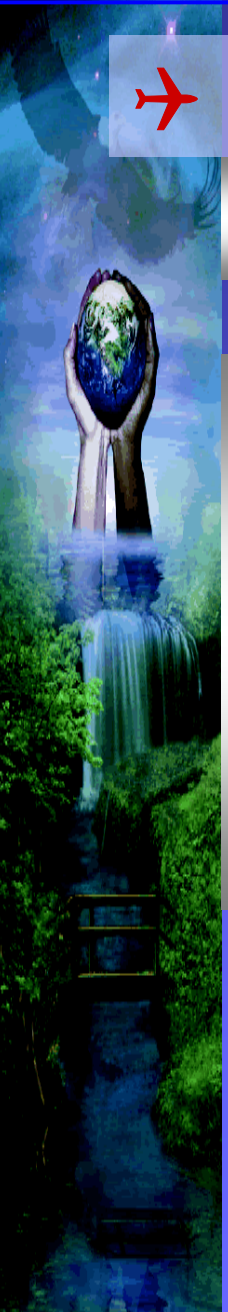
    TAP/ME started to manage solid wastes
  - 1999

    TAP/ME created a written procedure, NTM 08-27, establishing how to procede with each industrial waste and the appropriate routing

T8 Concerning INSUSTRIAL WASTES

In 1997, TAP/ME started to manage solid wastes, and
In December 1999, a written procedure (NTM 08-27) was created, establishing how to handling, conditioning and routing, for each industrial waste.

TAP, 9/19/2004



Historical Overview ...

environmental management system

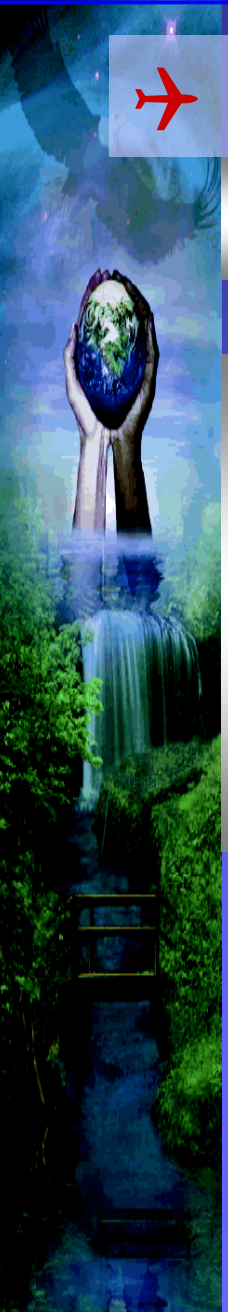
Jan 2003

TAP began a new cycle of Environmental Management Program (via a consulting company) with the aim of

ISO 14001 Certification
(expected by the end of 2006)

T9 In 2003, TAP began a new cycle of Environmental Management Program (via a consulting company), with the aim of ISO 14001 certification.

TAP, 9/19/2004



Historical Overview ...

C3P 2004 strategic project plan

2nd semester 2003

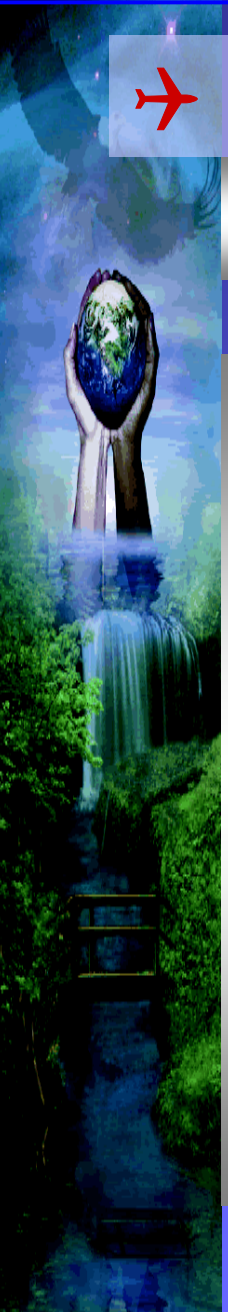
TAP/ME, together with other portuguese companies, **launched** with NASA/C3P, a global program for Pollution Prevention

C3P 2004 Strategic Project Plan

T10

Finally,
In the beggining of the 2nd semester of 2003, TAP/ME, together with other Portuguese companies, launched with NASA/C3P, a global program for Pollution Prevention.

The 'C3P STRATEGIC PROJECT PLAN'
TAP, 9/19/2004



Historical Overview …

C3P 2004 strategic project plan …

1st semester 2004

In this scene TAP (together with OGMA and C3P) assumed the commitment for:

- ***Replacement of high VOC coatings for aircraft painting and in general painting scheme***
- ***Replacement of Alodine 1200/1000 on Aluminium Alloys 2024, 6061 and 7075 in Aircraft Processing***
- ***Dem/Val of suitable alternatives to hexavalent chrome in primer coatings (Al 2024, 7075 and 6061)***
- ***Dem/Val alternatives to chrome and cadmium plating of fasteners and engine components; landing gear; turbine fans; etc***

T11

In this stage, TAP (together with OGMA and C3P), assumed the commitment for:

'Replacement of high VOC coatings, for aircraft painting and in general painting scheme'

'Replacement of Alodine 1200/1000 on Aluminium Alloys 2024, 6061 and 7075 in Aircraft Processing'

'Dem/Val of suitable alternatives to hexavalent chrome in primer coatings (Al 2024, 7075 and 6061)'
and
'Dem/Val alternatives to chromeand cadmium plating of fasteners and engine components; landing gear; turbine fans; etc'
TAP, 9/19/2004

Summary

- historical overview
- **wastewaters**
- gas emissions
- industrial wastes
- environmental management system
- c3p 2004 strategic project plan

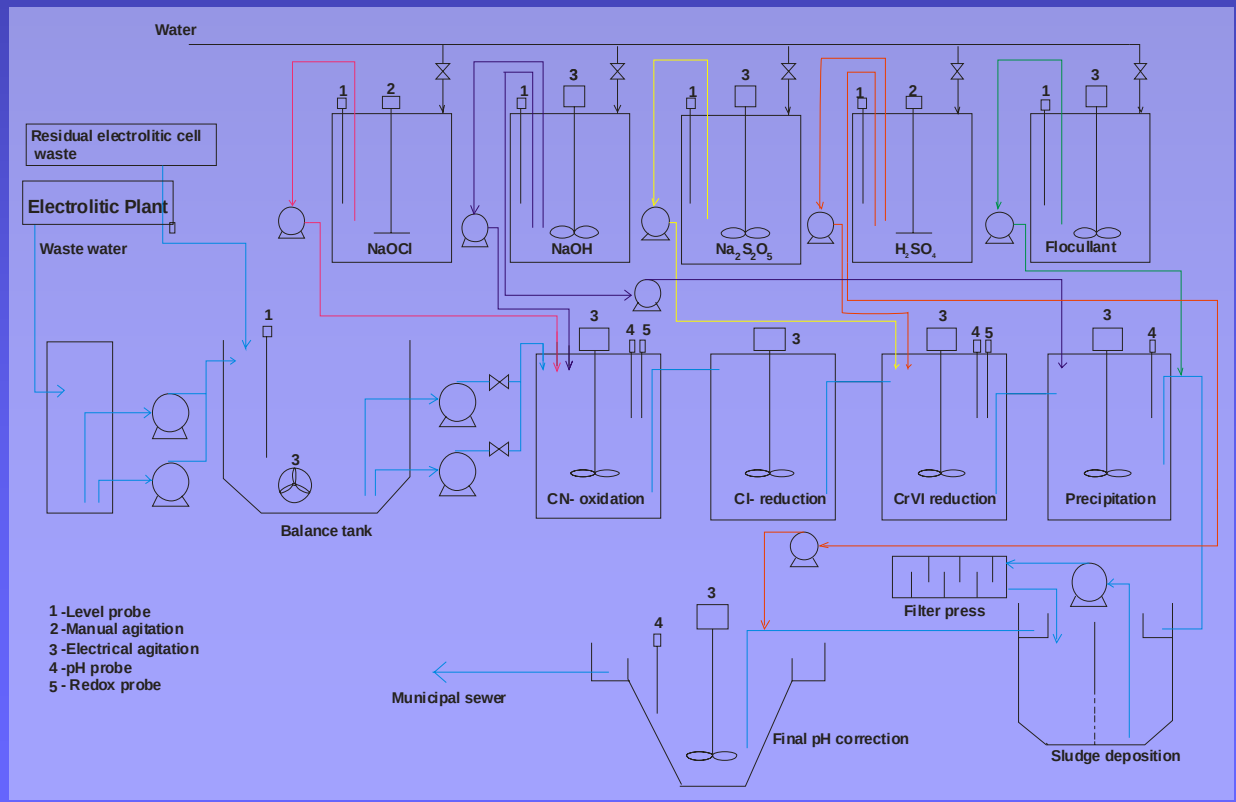
T13 Lets analyse our work on these fields:

WASTEWATERS
TAP, 9/19/2004

in detail ...

1988 – Wastewater Treatment Plant , WWTP

Waste Treatment Continuous Process



Ana Paula Matos, Ana Ricardo, Filipe Alves, Vitor Morgado
NASA, September 2004

T12

This picture shows you as a schematic diagram form type, the old WASTEWATER TREATMENT PLANT for all Plating Shop WASTEWATERS, acquired by TAP/ME, in 1988.

This Plant uses the Continuous Process of WASTEWATER Treatment.

The Residual WASTE (originated in electrolitic cell during destruction process, by oxidation, of cyanide stripping baths) together with WASTEWATERS proceeding from Plating Shop are drove to a balance tank.

The resulting FLOW STREAM undergoes thru a continuos and sequencial process, starting with:

Cyanide Oxidation, using Sodium Hypochlorite in alkaline medium,

followed by
Chlorine elimination

and
Chromium hexavalent reduction, using sodium bisulfite in acidic media.

The produced FLOW STREAM undergoes thru
Heavy Metals Precipitation in alkaline media, followed by flocculation, with sludges deposition.
The sludges are then collected in a filter press and routed for the Waste Manager.

Finally, the pH of clear water is corrected and therefore routed to the Public Sewer.

TAP, 9/19/2004

the process ...

1988 – Wastewater Treatment Plant , WWTP

Waste Treatment Continuous Process

Flow Stream characterization
Acids + Alkalis + Cyanides +
+ Metals (CrVI, Ag, Cd, Ni)

Cyanide oxidation
with sodium hypochlorite
at pH 11

Chlorine stripping

Cr VI reduction
with sodium bisulfite
in acidic media

Heavy metals precipitation
at pH 11 and flocculation

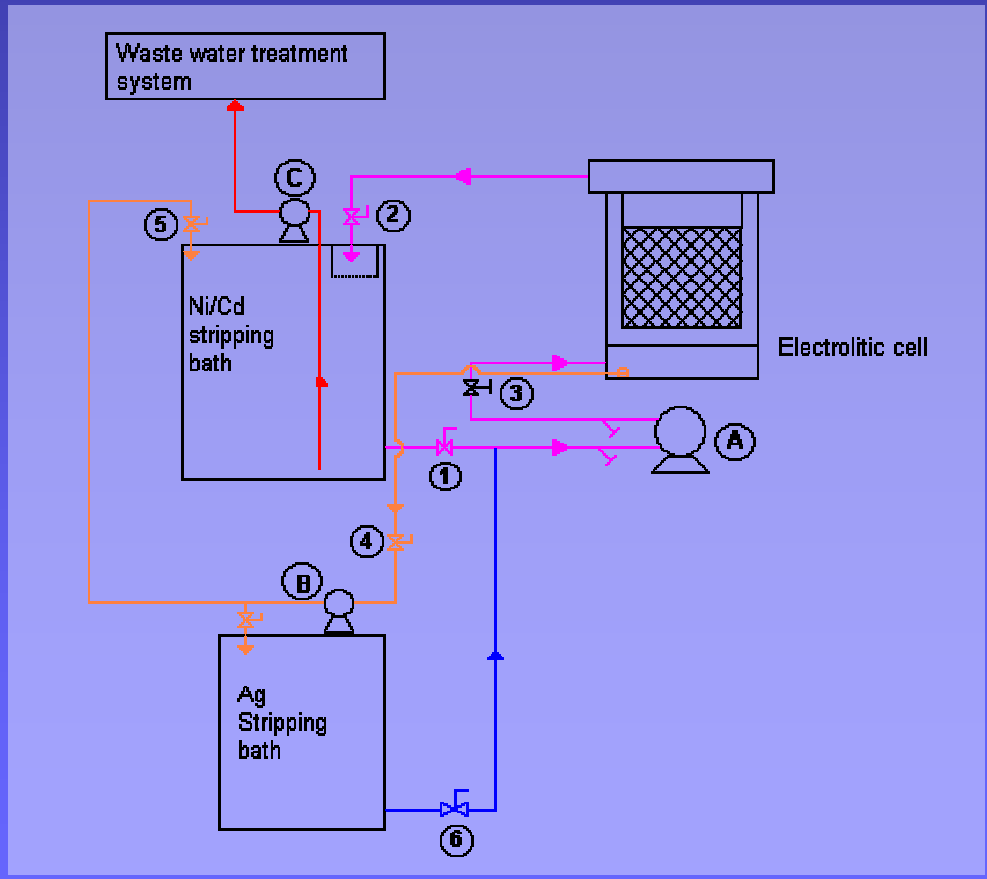
Final pH correction

T14 In a flow chart form type, we have the explanation of the previous process.

It must be emphasized that
The FLOW STREAM contains acids and cyanides together and that is the reason why, the process is so pH dependent!
TAP, 9/19/2004

in detail ...

1988 – Cyanide Stripping Bath Treatment Plant



T15 Concerning Cyanide Stripping Bath Treatment Plant...

The FLOW STREAMS proceeding from both cyanide stripping baths exhausted, are collected on the electrolitic cell system.

They are treated each a time, in order to collect pure metals, via reduction reaction, in alkaline media.
The oxidation reaction is, of course, cyanide destruction.

The process follows in a continuous loop until residual levels are obtained.
TAP, 9/19/2004

the process ...

1988 – Cyanide Stripping Bath Treatment Plant

Waste Treatment Continuous Process

Flow Stream characterization
Cyanide Stripping Bath ⊂
(Cd + Ni + Ag)

Cyanide oxidation + Metal Recovery
(via electrolytic process)

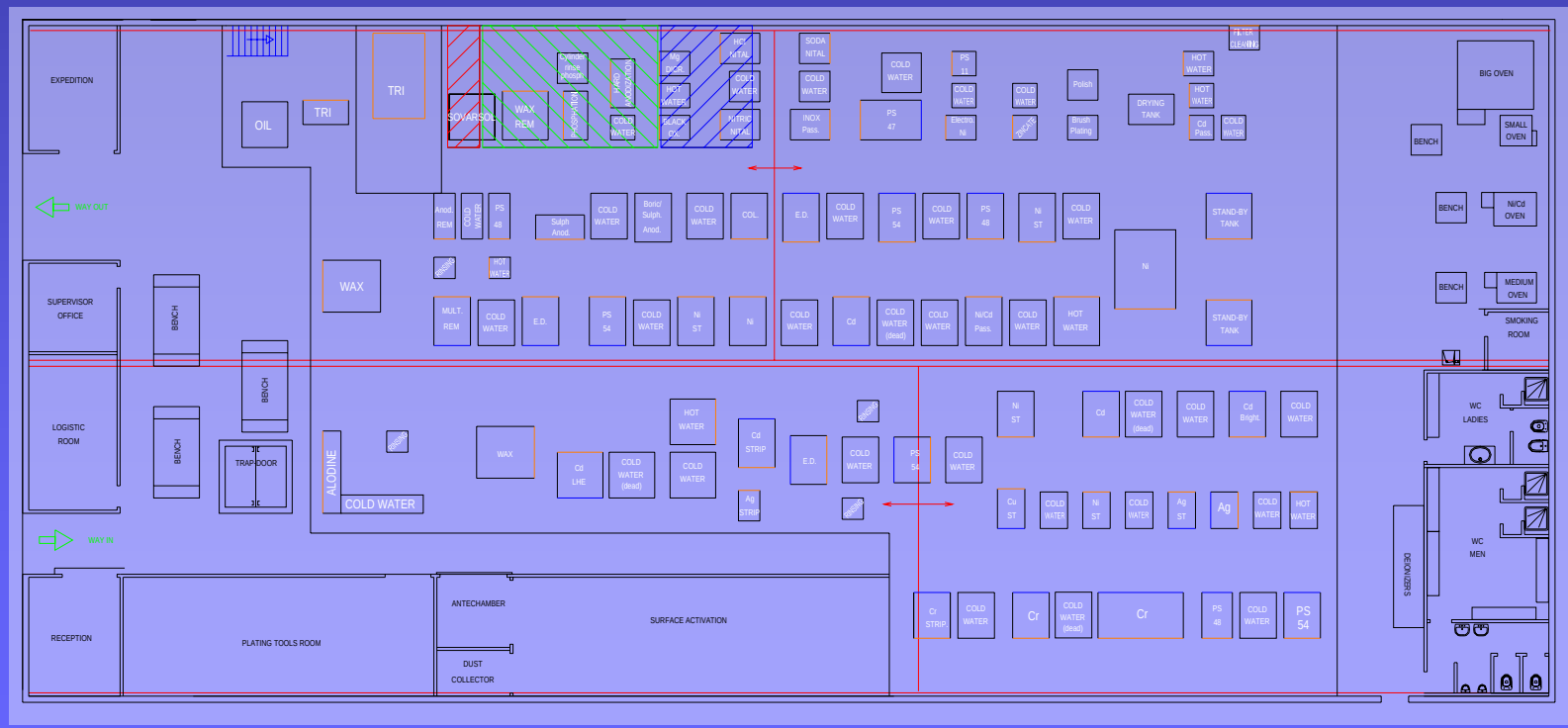
Residual waste
To the global waste water treatment plant

T16 In the flow chart here presented, we have the explanation of the process...

There is only a REMARK:
The obtained RESIDUAL WASTE undergoes thru the global WASTEWATER Treatment proccess, presented previously.
TAP, 9/19/2004

in detail ...

2001 – New Plating Shop



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Slide 16

T17 This slide shows you, in a shematic form type, the New Plating Shop, launched in 2001.
TAP, 9/19/2004

the environmental goals ...

2001 – New Plating Shop ...

Environmental goals assisted on this conception:

- ***Waste Water reduction***
  - ✓ *introduction of conductivity meters on rinse water tanks controlling the water admission on these tanks*
- ***Waste baths Components reduction***
  - ✓ *2-step dead rinse water tanks for make-up of baths*
- ***Separated Waste Water Streams and Gas emissions***
  - ✓ *Chrome*
  - ✓ *Cyanide*
  - ✓ *Alkali/Acid (non chrome and non cyanide)*
- ***Water Streams and Soils Contamination avoidance by emergency retention tanks for accidental bath discharge***

T18 It becames necessary to buil up a New Plating Shop, and Environmental, Health and Safety aspects were carefully cared:

'WASTEWATERS Reduction'
by the introduction of conductivity meters on rinse water tanks, controlling the water admission on these tanks

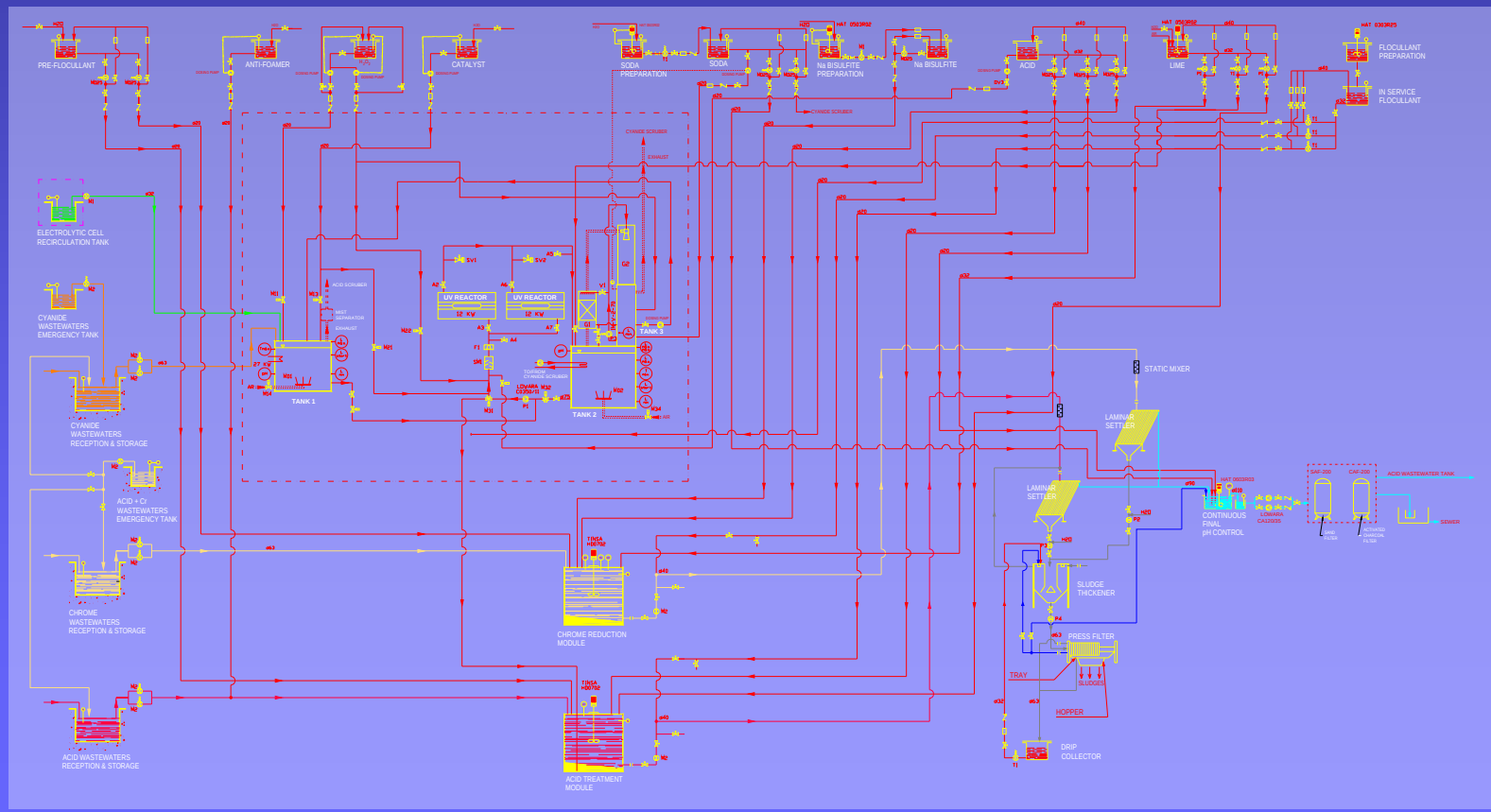
'WASTE BATH COMPONENTS Reduction'
via introduction of 2-step dead rinse water tanks for make-up of baths

'SEPARATED WASTEWATER STREAMS and GAS EMISSIONS', this is
Chrome line
Cyanide line
Alkali/Acid (non chrome and non cyanide) line

and
'WATER STREAMS and SOILS CONTAMINATION Avoidance'
by emergency retention tanks for accidental bath discharge.
TAP, 9/19/2004

in detail ...

2001 – WasteWater Treatment Plant, WWTP



Ana Paula Matos, Ana Ricardo, Filipe Alves, Vitor Morgado
NASA, September 2004

T19

This slide shows you, in a flow chart type form, the dedicated WWTP.

On the left hand side, from top to bottom, you can see poorly, the collection tank systems.

On the top from left to right hand side, you can see all the necessary chemicals, for the treatment processes.

On the middle left hand side, there is the cyanide destruction process.

On the middle down left hand side, we have the traditional methods for chrome and acid/alkaline treatments.

Finally,
On the middle down right hand side, there are the separation processes, and final pH correction.
TAP, 9/17/2004

the process ...

2001 – WasteWater Treatment Plant, WWTP...

Waste Treatment Traditional Method

Chrome line

Flow Stream characterization
Cr VI waste water

pH correction → 2.5

Cr VI reduction to Cr III
with sodium m-bisulfite addition

Cr III precipitation
with lime at pH = 8

Sludge separation and filtration → Cr III sludge

Acid / alkali line

Flow Stream characterization
Acid / Alkali waste water

pH correction → 11
for metals precipitation

Sludge separation and filtration → Metallic sludge

Final water pH correction
(pH 6-9)

Ana Paula Matos, Ana Ricardo, Filipe Alves, Vitor Morgado
NASA, September 2004

T20 In a flow chart form type, there is the detailed explanation of chrome and acid/alkali lines traditional treatment processes.
TAP, 9/17/2004

the process ...

2001 – WasteWater Treatment Plant, WWTP ...

Waste Treatment New Technology

Cyanide line

Flow Stream characterization
Cyanide waste water

Residual waste
from Electrolitic Cyanide
stripping bath destruction

Free cyanide oxidation
using hydrogen peroxide
and copper salt as catalyst
in alkaline media (pH =11)

Complex cyanide oxidation
using UV radiation
together with hydrogen peroxide
and copper salt as catalyst
in acidic media (pH = 2.5)

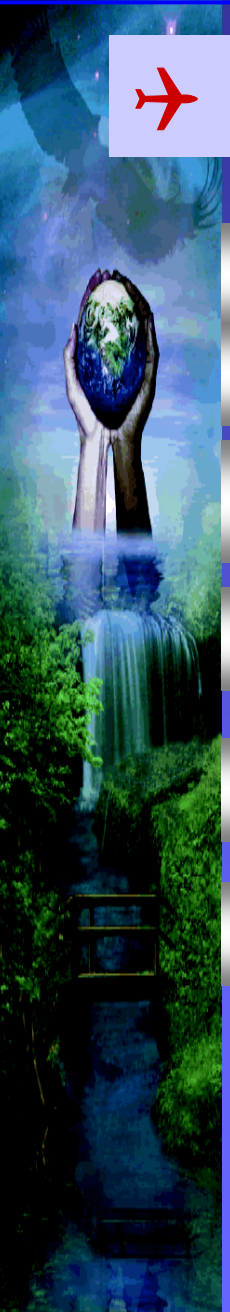
Residual waste
to the Acid / Alkali waste water
treatment process

T21 In the CYANIDE WASTES Case, there are two innovations:

The first is:
The use of an environmental friendly chemical, the hydrogen peroxide, as the oxidant, on both oxidation process.

The second is:
UV radiation assisting complex cyanide oxidation, using hydrogen peroxide which is a strong oxidant.

The copper sulphate is there to speed up the process.
TAP, 9/19/2004



Summary

- historical overview
- wastewaters
- gas emissions
- industrial wastes
- environmental management system
- c3p 2004 strategic project plan

T22 Concerning GAS EMISSIONS...

TAP, 9/19/2004

the environmental goals ...

1999/2000 – Engine Cleaning Shop

Environmental goals assisted on this conception:

- *... a completely renewed Cleaning bath exhaust System and a Scrubbing System installed*

2001 – Scrubbing System

Environmental goals assisted on this conception:

- *... together with the new plating shop facilities, all gas emissions are suitably treated by Scrubbing System*
  - ✓ *produced waters are routed to WWTP, as an integrated system*

T23

During 1999/2000
As previously presented, with the installation of the exhaust system for the Engine Cleaning Shop, the environmental requests that assisted the acquisition process were

a completely renewed cleaning bath exhaust system and a scrubbing system installed.

In 2001
A scrubbing system was installed together with the implantation of the new plating shop, as an environmental goal.
Similarly to the new plating shop, 3 lines of gas scrubbing were installed:
One for chrome, one for cyanide and one for acids/alkalis.
Produced WATERS are routed to WWTP as an integrated system.
TAP, 9/19/2004

the environmental goals ...

2004 – Natural Gas

Environmental goals assisted on this conception:

- ***All Steam and hot Water boilers are ready to Operate with Natural Gas***
  - ✓ ***until now, they are fueled with thick fuel oil***

T24 In 2004

All steam and hot water boilers are ready to operate with natural gas, only waiting final authorization for system connection.

Until now, these heating devices are still, fueled, with thick fuel oil.

TAP, 9/19/2004

Summary

- historical overview
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- **industrial wastes**
- environmental management system
- c3p 2004 strategic project plan

T25 Concerning INDUSTRIAL WASTES...

TAP, 9/19/2004

the procedure, why?...

1999 – Industrial Waste Management Procedure

NTM NO. 08-27 | NORMAS TÉCNICAS DE MANUTENÇÃO | TAP AIR PORTUGAL

INDUSTRIAL RESIDUES MANAGEMENT

REVISION NO.	DATE	TOTAL NO. OF PAGES
0	31 DEC 1999	8

0. CONTENTS

1. Objective
2. Scope
3. Definitions
4. References
5. Responsibilities
6. Industrial Residues Management Procedures

1. OBJECTIVE

This rule aims at establishing procedures for gathering, segregation and temporary storage of several types of industrial residues generated in the various DGME Areas.

2. SCOPE

This rule applies to all solid or liquid industrial residues proceeding from any DGME Area.

3. DEFINITIONS

Residues - Any substances or objects the holder gets rid of or intends or is obliged to get rid of.

Dangerous residues - residues evidencing characteristics liable to be dangerous to health or the environment.

Storage - Temporary and controlled deposition, for a definite time, of residues prior to their treatment, valorisation or elimination.

Residues isolation - selective collection in appropriate containers.

	PREPARED	REVISED	VERIFIED	APPROVED
NAME	Filipe Alves Ana P. Matos		Maria João Cardoso	J. Picado Floro
DEPARTMENT	DGME/QLD/EG		DGME/QLD/EG	DGME/QLD

- Aircraft / Engine / Components Maintenance Processes
- Material Stock Management

↓

Quantity + Diversity
Industrial Waste

↓

NTM 08- 27

↓

- How to **Handle**
- How to **Condition**
- How to **Route** for temporary internal disposal

T26

Due to the huge quantity and diversity of wastes, proceeding from all TAP maintenance processes, there was a real need to create a procedure identifying the several wastes and defining the waste management process for each one.

And so, NTM 08-27 was issued ...

TAP, 9/19/2004

to inform...

1999 – Industrial Waste Management Procedure ...

- *the Procedure was Created to inform and discipline Production Areas Attitudes*
  - ✓ *regarding their own wastes, establishing the internal circuits for different kinds of wastes, including temporary storage*
- *in parallel, a Procurement of waste management companies was initiated, to establish the final destination of the different Industrial Wastes:*

  e.g.

  recycling,
  destruction,
  landfilling,
  ...

T27

With the procedure a new mentality was created regarding information, consciousness and discipline, on production areas attitudes, concerning their own wastes management.

In the other hand a procurement of waste management companies was initiated, to establish the final destination of each industrial waste category,

Such as:
Recycling,
Destruction
Landfilling
...

TAP, 9/19/2004

the industrial wastes...

1999 – Industrial Waste Management Procedure ...

Industrial Wastes

- *some examples are*
  - ✓ *lubricating oils, hydraulic fluids and emulsified cutting fluids*
  - ✓ *sludges from WWTP and plasma spray processes*
  - ✓ *metallic and non-metallic materials*
  - ✓ *solvents*
  - ✓ *shelf-life expired maintenance products*
  - ✓ *blasting powders*

T28 Some examples of industrial wastes categories are:

Lubricating oils, hydraulic fluids and emulsified cutting fluids;
Sludges from WWTP and plasma spray processes;
Metallic and non-metallic materials;
Solvents;
Shelf-life expired maintenance products;
and
Blasting powders.

TAP, 9/17/2004

Summary

- historical overview
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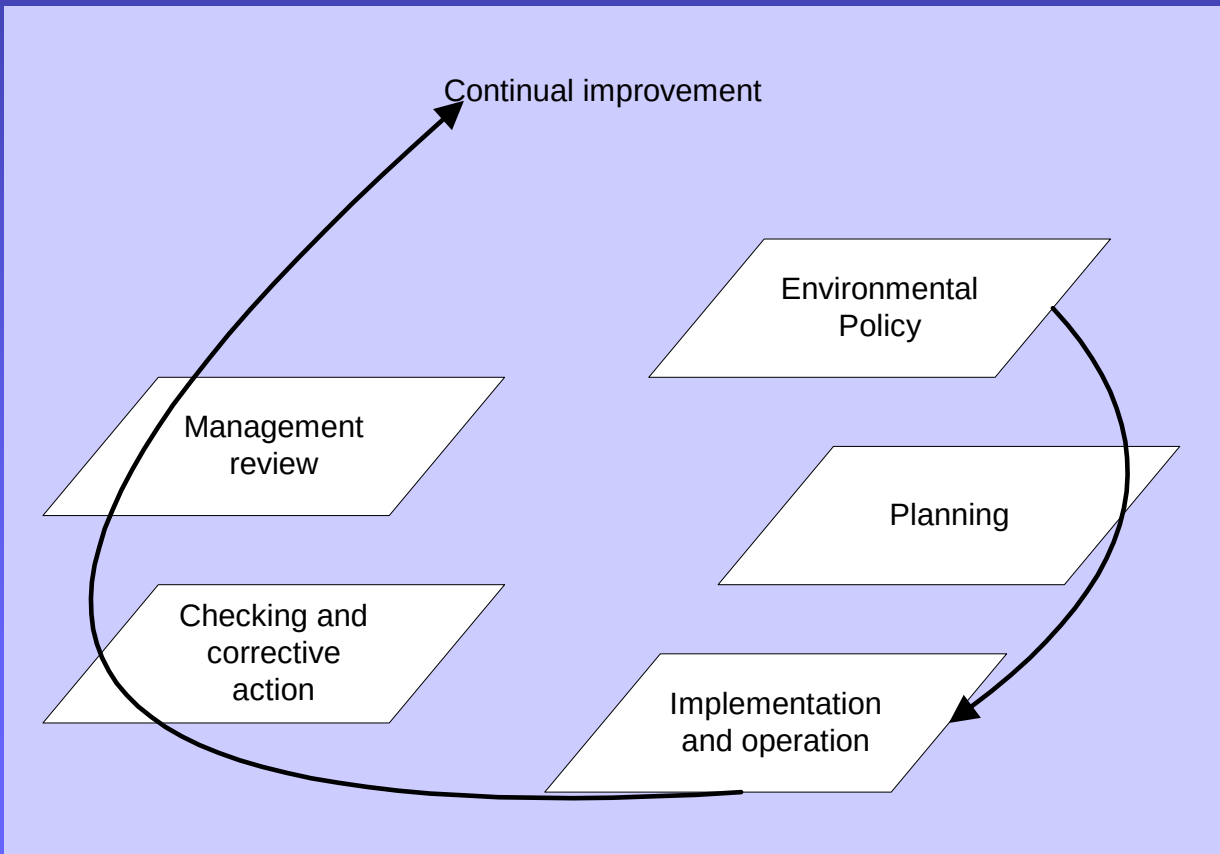
- c3p 2004 strategic project plan

T29 Concerning ENVIRONMENTAL MANAGEMENT SYSTEM implementation program...
TAP, 9/19/2004

the process ...

2003/2004 – Environmental Management System

Plan Do Check Act



T30 During 2003/2004

Following PDCA cycle defined by ISO 14001, TAP started the program implementation.

In accordance with Environmental Policy, defined by the higher management of each company, a Planning-P is defined, Doing-D the planned works by implementation and operation of correct systems to attain the goals previously defined.

Thru internal and external audits and measurement and control processes, the system is Checked-C.

Annualy the system is reviewed by higher management and new goals will be defined. This is the meaning of Act-A.

The cycle as a whole constitutes Continual Improvement.

TAP, 9/19/2004

in detail ...

2003/2004 – Environmental Management System

Plan Do Check Act ...

- **February 2003**
  - ✓ *Consulting company visit, to TAP facilities*
- **March to December, 2003**
  - ✓ *Processes identification*
  - ✓ *Applicable legal requirements identification*
  - ✓ *Environmental aspects identification*
- **January 2004 until now**
  - ✓ *Environmental impacts evaluation*
  - ✓ *Procedures formulation for system support*

T31 This program shows:

The Knowledge of all maintenance processes,
The INs and OUTs of these processes
and
The Environmental Impact.

TAP, 9/19/2004

in detail ...

2003 – Environmental Management System ...

Tasks to Develop \ Month	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Observations
Visit to the Facilities and Procedures Analysis																					**27 and 28 of February**
Environmental Survey																					
To Fulfil IAA Forms																					
To Group IAA Forms by Service/Business Unit Series																					
Environmental aspects classification definition																					
Training																					**Phase I**
Lecture on "Environmental Management System Implementation at TAP AIR PORTUGAL"																					**3 Hours**
Environmental Aspects Evaluation																					
Training																					**Phase II**
"Environmental Management System" Training Course																					**4 Hours**
Environmental Management System Conception																					
Environmental Management System Implementation																					
Training																					**Phase III**
Sensitizing Training Session on "Environmental Policy at TAP AIR PORTUGAL"																					**3 Hours**
Training Session on "General Environmental Procedures"																					**4 Hours**
Training Session on "Environmental Management System Operational Control"																					**4 Hours**
Training																					**Phase IV**
Brainstorming "Environmental Management System Performance"																					**3 Hours**
Training Session on "Audits to the Environmental Management System"																					**4 Hours**
Internal Audit																					

T32 In this slide you can see the Planning for Environmental Management System implementation.

TAP, 9/19/2004

Summary

- historical overview
- waste waters
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- C3P 2004 strategic project plan

T33 At least

C3P 2004 Strategic Project Plan

TAP, 9/19/2004

in detail ...

2nd semester 2003

- **July 2003**
  - ✓ *NASA/C3P visit, to TAP facilities*
- **September 2003**
  - ✓ *NASA/C3P Assessment Report*
  - ✓ *C3P and NASA Technical Workshop on,* ***'Integrating Common Problems for Shared Solutions'***
    - ***Protocol signature by***
      TAP/ME Representative
      OGMA Representative
      C3P Representative
      ...

T34

Started during the 2nd semester of 2003, with the
Visit of NASA/C3P Representatives to TAP facilites.

In September 2003
NASA/C3P Assessment Report was issued
and more or less at the same time
the Technical Workshop on
'Integrating Common Problems for Shared Solutions'
ocurred at IST facilities.
The project was then officialized, with protocol signature by the involved partners.

in detail ...

2004

- **January 2004**
  - ✓ *(C3P) 2004 Strategic Project Plan OGMA & TAP Report with projects presentation/definition*
- **April 2004**
  - ✓ *TAP (together with OGMA and C3P) assumed the commitment for:*
    - ***Replacement of high VOC for aircraft painting and in general painting scheme***
    - ***Replacement of Alodine 1200/1000 on Aluminum Alloys 2024, 6061 and 7075 in Aircraft Processing***
    - ***Dem/Val of suitable alternatives to hexavalent chrome in primer coatings (Al 2024, 7075 and 6061)***
    - ***Dem/Val alternatives to chrome and cadmium plating of fasteners and engine components; landing gear; turbine fans; etc***

T35

In January 2004
A project definition was presented for approval to OGMA and TAP people

In April 2004
TAP (together with OGMA and C3P) assumed the commitment for
'Replacement of High VOC for Aircraft Painting and in General Painting Scheme'
'Replacement of Alodine 1200/1000 on Aluminium Alloys 2024, 6061 and 7075, in Aircraft Processing'
'Dem/Val of Suitable Alternatives to Hexavalent Chrome in Primer Coatings (Al 2024, 7075 and 6061)'
and on
'Dem/Val Alternatives to Chrome and Cadmium Plating of Fastners and Engine Components, Landing Gears, Turbine Fans, etc'
TAP, 9/19/2004

in detail ...

2004 ...

- **June 2004**
  - ✓ *'Replacement of Alodine 1200/1000 on Aluminum Alloys 2024, 6061 and 7075 in Aircraft Processing' project started up with*
    - ***TAP/ME Alodine process line data call accomplishment***
    - ***NASA/C3P Potential Alternative Report accomplishment and continuous reviewing***

T36

In June 2004
The Alodine 1200/1000 replacement project was started, with the Accomplishment of
'TAP/ME Alodine Process Data Call'

and with the Accomplishment and Continuous Reviewing
'NASA/C3P Potential Alternative Report'
TAP, 9/19/2004

in detail ...

2004 ...

- **July 2004**
  - ✓ *Meeting at OGMA facilities to discuss alternative products to Chrome Conversion Coatings (Alodine 1200/1000)*

    3 alternative products were referred:

    Alodine 5200, Alodine 5700 and PreKote

    - ***NASA/C3P had made available a Potential Alternative Product Report – 'Position on PreKote', by Air Force Corrosion Prevention and Control Office***
    - ***NASA/C3P had made available Boeing Engineering Approval and Test Matrix on PreKote***

    ¡ PreKote requires the use of chromated primer !

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In July 2004

During the meeting at OGMA facilities, 3 alternative products for Alodine 1200/1000 were referred.

the products were:
Alodine 5200 and 5700
and PreKote

NASA/C3P, had made available reports on the behaviour, characterization and approval, under certain limits, on PreKote.

!However this product requires the use of a chromated primer!

So,
We eliminate hexavalent chrome from chemical conversion coatings, and we will use hexavalent chrome on the primer that PreKote requires!
Where is the advantage?

and
How is this compatible with Replacement of Chromated Primers project?
TAP, 9/19/2004

in detail ...

2004 ...

- **September 2004**
  - ✓ *NASA and C3P Workshop on* ***'International Pollution Prevention'***
  - ✓ ***'Replacement of High VOC coatings for Aircraft Painting and in general painting scheme'*** *project shall start up*

T38

And here we are
At NASA/C3P Workshop on
'International Pollution Prevention'

During which shall start the VOC replacement project on Aircraft Painting.
TAP, 9/19/2004

in detail ...

Future

- Successful accomplishment of all projects with implementation of the alternative products/processes for a

BETTER WORLD TO LIVE ON

Thanks for Your Attention ...

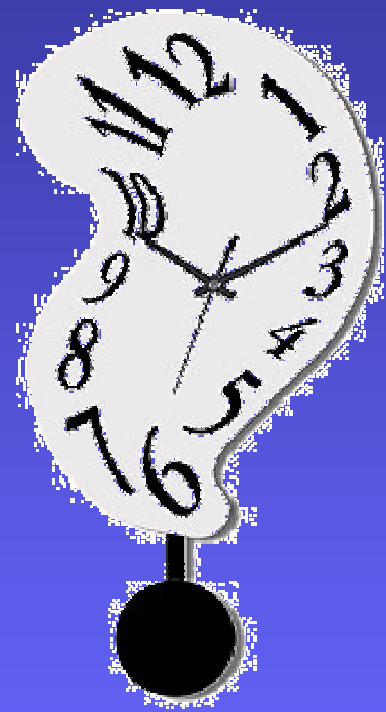
T39

For the Future we hope

The successful accomplishment of all projects with implementation of the alternative products and processes for a

BETER WORLD TO LIVE ON

TAP, 9/19/2004



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NASA, September 2004