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United Nations Industrial Development Organization

Vienna

INTERREGIONAL PROMOTION AND IMPLEMENTATION OF CLOSING-THE-LOOPS COOPERATION AND BUSINESS MODELS IN THE CHEMICAL INDUSTRY

DRAFT FINAL REPORT

2009

Project Manager: Petra Schwager, PTC/EMB Branch

January 31/2009

Content

1. Executive Summary

Four new companies have signed the letters of intent and 2 couples are very close to green light the implementation in their processes looking for new trade strategies with eco optimization models.

The next new case to be signed is between CI Colauto and Electrowest Chemicals (supplier).

New sectors explored during the year 2009: coatings and paints, textile, resins and specialties, functional chemicals in coating auxiliaries, office buildings, metal finishing, new fields in agrochemicals such as flower paints and service companies which use cleaning solvents.

Visits and electronic information were the basis for the status quo of each individual case to optimize.

There was an international workshop in August with important new companies in several sectors like pharmaceutical and chemical.

There were also multiple national meetings in cities as Bogota, Medellin and Cali with the participation of national and local environmental authorities.

Activities realized during this period

The following issues were the main focus of the Chemical Leasing activities in Colombia during the year 2009:

- Dissemination of the concept for more than 30000 contacts between companies (old and new enterprises in ChL). This goal was achieved through e-mails and massive communications in NCPC.
- Presentation of successful cases in Colombia in large, medium and small companies.
- Organization of international workshops and national meetings with environmental authorities and private companies from several industry sectors.
- Monitoring and evaluation of the pilot cases with Ecopetrol - Nalco, Grival - Tecca and Armalco - Dismongo.
- Quick scan and first visits to companies with a high potential to start new Chemical Leasing cases in Medellin,Cali and Bogota.
- Evaluation of the specific potential optimization under the Chemical Leasing

concept in plants.

- Signing of new letters of intent for companies related to automotive industry
- Design of a new poster for Chemical Leasing
- Design of a new brochure to create more impact in the companies
- Elaboration of annual work plans and financial calculations for 2009

2. DISSEMINATION OF THE CHEMICAL LEASING CONCEPT AND GLOBAL FORUM ACTIVITIES

Raising awareness and dissemination activities

Topic	**Date/Duration**	**Type of participants (e.g. companies, government, etc.)**
Visit to Ecopetrol ,Grival and Armalco	18 March	Companies
Visit to Asocolflores	19 March	Flower users and cultivators.
ChL dissemination	5 March	Metromed
ChL Dissemination	20 March	UCO (Universidad Catolica del Oriente)
Agreement cooperation	5 April	Environmental Ministry
EAFIT University	3 April	Training with students and professors from process engineering
Agreement cooperation EAFIT University	12 April	Dean of the program : Paula Hernandez
Cooperation Agreement	14 April	ANDI (Asociacion Nacional de Empresarios e Industriales)
ChL in Calcium Hydroxide. Visit to plant with supplier (Jorge Mora Ingenieros Co.)	7 May	Between companies from Industrial Gases Chamber and Jorge Mora Ingenieros Company
Agreement cooperation with ANDI (Asociación Nacionalde Empresarios e Industriales)	18 May	Oxigenos de Colombia and Agafano Co.
ChL promotion for students and researchers from ZERI (Zero Emissions) in EAFIT University	August 10	EAFIT University
Sustainable Energy Models and Chemical Leasing	July 16	Corporación Empresarial del Oriente CEO

Appliance		
Meeting at EAFIT university for the advances in the work team in ChL(work plan)	August 14	EAFIT University
Meeting at Camacol (Ant) in order to elaborate a strategic plan with ANDI and its Industrial Gas Chamber	August 19	ANDI Medellin
Workshop 2009	August 23 - 27	
Green chemistry strategies and chemical leasing.	September 15	TEPSA
Chemical Leasing as an instrument in innovative negotiations	September 16	IMUSA (Industrias Metalurgicas S.A.)
Chemical Leasing and Life Cycle assessment	September 28	Environmental authorities
Chemical Leasing and sound chemical management	Tuesday 13th	EAFIT University
Chemical Leasing principles	November 11	Chemical Leasing companies interested in starting pilot cases in the year 2010

3. TRAINING OF NATIONAL EXPERTS

ChL Dissemination	4 March	Sumicol
Environmental performance	14 April	Armalco
Format to collect information	14 April	Grival
Environmental indicators	14 April	Ecopetrol
Format to collect information	14 April	Asocolflores
Implementation of the basis of payment	13 May	Armalco
Environmental indicators-review of these technical goals.	13 May	Ecopetrol
Chemical Leasing Model	July 31	Manufacturas Muñoz
Chemical Leasing in Waste water treatment Re starting chl appliance	Chemical Diesel Formaldehyde	Interquim AKZO NOBEL
Meeting in CEO (Rionegro Ant) to check advances in Sustainable Chemical Management and ChL strategies	August 20	Corporacion Empresarial del Oriente
Visit to Flores el Capiro in Rionegro (Ant) to start the pilot case evaluated at Asocolflores	August 18	RIonegro Antioquia
Teleconference to monitor advances and evaluation indicators	August 12	Corona - Grival
Contract parameters in Chemical Leasing negotiations	September 4	El Capiro
Chemical Leasing in gas	September 10	Cryogas

industry		
Chemical Leasing case with El Capiro (Asocolflores)	September 17	Brenntag
Auteco	14th October	Auteco & CI Colauto
Chemical Leasing opportunities	November 18	RSE (Social Enterprise Responsibility – ANDI institution)

4. DEVELOPMENT OF CHEMICAL LEASING TOOLS

Participation in the redesign of the Tool kit for the new edition of the Chemical Leasing goes global text.

Parts of the new tool:

Worksheets:

1. Case study.

2. Quick scan survey.

3. Agenda template plant level.

4. Cooperation agreement.

Annex 1 Terms of reference.

Annex 2 General conditions of the contract.

5. Project assessment in plant

6. Documents

Chemical Leasing guidelines.

5. ASSISTANCE PROVIDED TO COMPANIES PARTICIPATING IN THE ON GOING PROJECTS AND THE NEW COMPANIES IDENTIFIED

5.1 Status summary and results of the Chemical Leasing projects

Current cases in ChL :

A) Armalco (User) and Dismongo(supplier):

Armalco is designing with its supplier new strategies to reuse the HCl waste in the degreasing process (Bayer's representative). At the very beginning it has been a little difficult to set the kind of resins from Rohm and Hass to evaluate the immobilization of the Iron in HCl media.

The pilot plant constructed by Armalco was used by Biocidas y Quimicos (Bayer's representative) to realize the tests.

Pilot Plant .Ionic Exchange implementation

This user enterprise is testing with the help of Dismongo the new formulation MonNocarbon that is showing important benefits in economic terms for the company.

Performance and tasks developed by these companies without the chemical leasing project this period:

		JUL	AUG	SEPT	OCT	NOV
MON NOCARBON B	liters	120	60	120	240	40
water		480	0	360	480	0
total solution		600	660	480	720	760
dilution		1 A 4	1 A 3	1 A 3	1 A 2	1 A 1,7
type of wire washed						
high carbon	tn	10,36	33,88	31,36	36,68	12,32
low carbon		0	0	15,96	0,56	0
total washed wire		**10,36**	**33,88**	**47,32**	**37,24**	**12,32**
average washings hours per chipa	h	4	6	4	6,5	6

At this point Armalco is trying to implement the chemical leasing model in the first stage of the galvanizing process through the shown scheme but in the work plan created with NCPC just 10% of the total final product is using this new raw material just to make a good approach to the production goal without any technical problem.

There's a specific problem to solve in the first tank and it is about pH measurement, looking for a constant in the concentration level.(H+ ions) .

The last situation is still under evaluation at the company, and that is why NCPC has made another contact with Bayer Co in order to evaluate the Lewatit Monoplus MP 64 (0,5L) ® from Bayer because its representative in Colombia (Biocidas y Quimicos) has signed a letter of intent as well with the NCPC for the chemical leasing project.

The following tests were carried out by the companies looking for the best knowledge of the process in order to optimize the methodology.

B) Corona Grival (User) and Tecca(supplier):

Grival-Tecca in a teleconference discussed the advances achieved during 2009 and the projections for the year 2010.

NCPC thinks this case has been one of the best example without the ChL project and definitely it should be very demonstrative and illustrative for future cases developed around the world.

Corona is developing with Tecca strategies to reduce water consumption and chemicals like NaOH, SodiumTripolyphosphate , Metabisulfite,Calcium Oxide, and Sodium Carbonate in reverse osmosis plants.

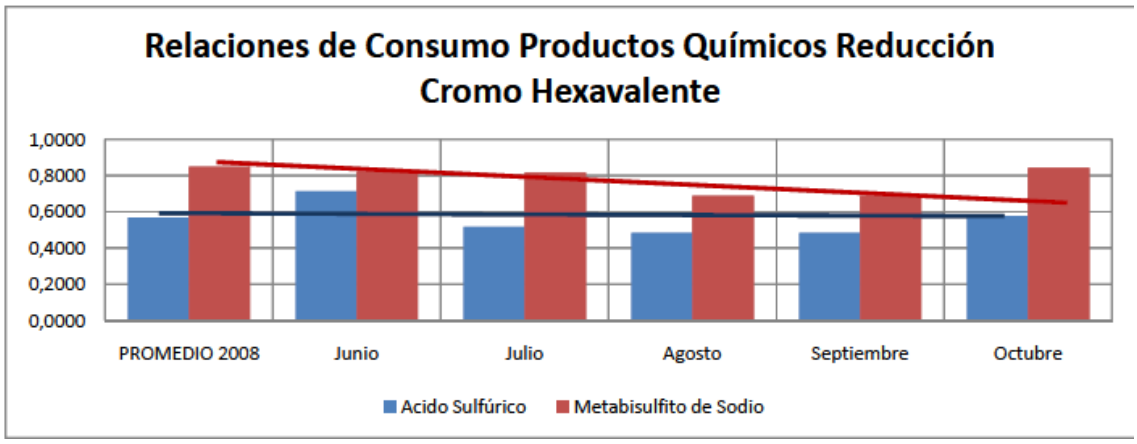
Indicators collected:

MONTHLY CONSUMPTION LIST (CHEMICAL LEASING)

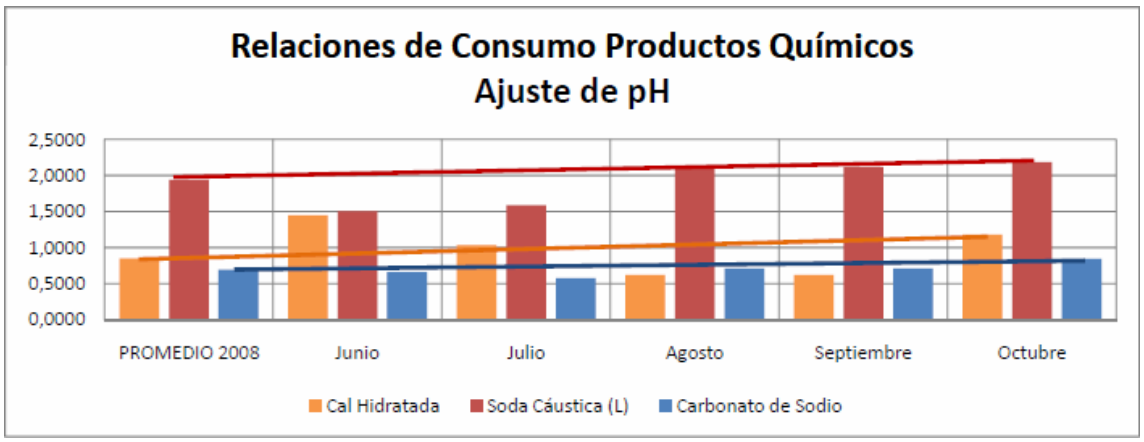
RELACIONES DE CONSUMO MENSUALES
LEASING QUÍMICO

Productos	PROMEDIO 2008	Junio	Julio	Agosto	Septiembre	Octubre	PROMEDIO 2009
Acido Sulfúrico	0,5690	0,7123	0,5167	0,4824	0,4824	0,5769	0,5542
Metabisulfito de Sodio	0,8480	0,8219	0,8148	0,6892	0,6892	0,8413	0,7713
Cal Hidratada	0,8492	1,4466	1,0334	0,6203	0,6203	1,1779	0,9797
Soda Cáustica (L)	1,9363	1,5014	1,5859	2,1158	2,1158	2,1827	1,9003
Carbonato de Sodio	0,6950	0,6575	0,5763	0,7064	0,7064	0,8413	0,6976
Ácido Clorhídrico	0,1550	0,0685	0,1391	0,0086	0,0086	0,0000	0,0450
Hipoclorito de Sodio	0,0552	0,0000	0,0000	0,0379	0,1338	0,1635	0,0670

HEXAVALENT CHROMIUM REDUCTION PRODUCTS CONSUMPTION LIST



pH ADJUSTMENT CHEMICAL PRODUCTS CONSUMPTION LIST



PRODUCTS PRICE VARIATION AND PRICE IMPACT PER CUBIC METER

VARIACION DE LOS PRECIO DE LOS PRODUCTOS

Productos	2008	2009	Varición
Acido Sulfúrico	$ 1.275,00	$ 930,00	-27,1%
Metabisulfito de Sodio	$ 2.000,00	$ 3.600,00	80,0%
Cal Hidratada	$ 448,27	$ 667,00	48,8%
Soda Cáustica (L)	$ 1.345,00	$ 1.250,00	-7,1%
Carbonato de Sodio	$ 1.398,00	$ 1.450,00	3,7%

IMPACTO DE LOS PRECIOS SOBRE EL METRO CUBICO

Productos	RELACION CONSUMOPROMEDIO 2008	RELACION CONSUMO PROMEDIO 2009	Variación Relaciones Consumo
Acido Sulfúrico	0,5690	0,5542	-2,6%
Metabisulfito de Sodio	0,8480	0,7713	-9,0%
Cal Hidratada	0,8492	0,9797	15,4%
Soda Cáustica (L)	1,9363	1,9003	-1,9%
Carbonato de Sodio	0,6950	0,6976	0,4%

RELATION AVERAGE CONSUMPTION 2008 AND 2009

PRECIO DEL METRO CUBICO EN 2008 E IMPACTO DE LOS PRODUCTOS SOBRE EL PRECIO

Productos	RELACION CONSUMOPROMEDIO 2008	Precio ($/Kg)	Precio ($/m3)	Porcentaje del Precio
Acido Sulfúrico	0,5690	$ 1.275,00	$ 725,48	11,4%
Metabisulfito de Sodio	0,8480	$ 2.000,00	$ 1.696,00	26,6%
Cal Hidratada	0,8492	$ 448,27	$ 380,67	6,0%
Soda Cáustica (L)	1,9363	$ 1.345,00	$ 2.604,32	40,8%
Carbonato de Sodio	0,6950	$ 1.398,00	$ 971,61	15,2%
		TOTAL M3	**$ 6.378,08**	**100%**

PRECIO DEL METRO CUBICO EN 2009 E IMPACTO DE LOS PRODUCTOS SOBRE EL PRECIO

Productos	RELACION CONSUMO PROMEDIO 2009	Precio ($/Kg)	Precio ($/m3)	Porcentaje del Precio
Acido Sulfúrico	0,5542	$ 930,00	$ 515,37	7,0%
Metabisulfito de Sodio	0,7713	$ 3.600,00	$ 2.776,61	37,9%
Cal Hidratada	0,9797	$ 667,00	$ 653,44	8,9%
Soda Cáustica (L)	1,9003	$ 1.250,00	$ 2.375,37	32,4%
Carbonato de Sodio	0,6976	$ 1.450,00	$ 1.011,52	13,8%
		TOTAL M3	**$ 7.332,32**	**100%**

CUBIC METER PRICE IN 2009 AND IMPACT OF THE PRODUCTS ON THE PRICE

IMPACTO DE LOS PRODUCTOS SOBRE EL PRECIO

Productos	Porcentaje del Precio	Porcentaje del Precio
Acido Sulfúrico	11,37%	7,03%
Metabisulfito de Sodio	26,59%	37,87%
Cal Hidratada	5,97%	8,91%
Soda Cáustica (L)	40,83%	32,40%
Carbonato de Sodio	15,23%	13,80%

PERCENTAGE OF ACCOMPLISHMENT OF SUGGESTED TASKS

PORCENTAJE CUMPLIMIENTO DE TAREAS PLANTEADAS

Tarea Programada	Porcentaje Cumplimiento	Pendientes y Observaciones
REVISIÓN GENERAL DEL SISTEMA	100%	
Revisión Estado General de La Planta	100%	
Revisión de los Sistemas de Control	100%	
PRUEBAS DE TRATABILIDAD	100%	
Pruebas Con Agua Mezcla	100%	
Pruebas Con Agua Crómica	100%	
IMPLEMENTACION DE LAS MEJORAS DEL	63%	
Implementación de los Análisis	100%	
Implementación de las Pruebas	25%	Se iniciaron las pruebas de TTF
Implementación del tratamiento	100%	
Seguimiento de la Vida Útil de los Consumibles	10%	No se llevan registros
PRUEBAS PARA RECIRCULAR LODO	75%	
Pruebas de Jarras	100%	
Pruebas En Planta	50%	Se sugiere repetir pruebas haciendo medición TTF
PRUEBAS DE RECUPERACION DE CAL	0%	
Pruebas de Jarras	0%	Pendientes
Pruebas en Planta	0%	Pendientes
RECUPERACION DE METALES DE LOS EFLUENTES DE PROCESO	70%	
Investigación de Tecnologías Existentes	50%	En Proceso
Pruebas de Recuperación Con Resinas de Intercambio	90%	Pendiente Recuperación de Níquel de la desorción de la resina
Otras Pruebas de Recuperación	0%	
Análisis de Viabilidad Económica	0%	
PROMEDIO GENERAL	**67,9%**	

Grival has asked NCPC to start a new ChL case with their provider Mc Dermid because they want to apply this strategy in other processes like galvanic.

Due to this request NCPC has elaborated a letter in order to involve the company and to send this communication to Mc Dermid showing their most important benefits achieved in economic and environmental terms.

Tecca has been working in improvement projects discussed with NCPC in plant handling, and several potential reduction opportunities in chemical uses:

- Cost of chemical used in plant as an overall cost
- Use of chemicals and consumptions for CaCO3 and CaO2
- Amount of recycled sludge in reverse osmosis unit.
- Solid waste as a chrome residue.
- Efficiency in first and second stage of the waste water treatment.
- Use of 350 and 40 micros for the process

Ongoing projects in the short future:

- Mechanic mixing for the water treatment (not only venting process)
- In the galvanizing process which is still under evaluation an in-situ waste water treatment with ionic exchange resins

Corona is developing with Tecca strategies to reduce water consumption and chemicals like NaOH, SodiumTripolyphosphate , Metabisulfite,Calcium Oxide and Sodium Carbonate in the reverse osmosis plant.

Indicators will be examined with the company in november in order to evaluate improvements under the chemical leasing project with Tecca.

C) Ecopetrol (User) and Nalco(supplier):

Process: Water clarification and crude dehydration in Castilla field–Villavicencio Colombia-

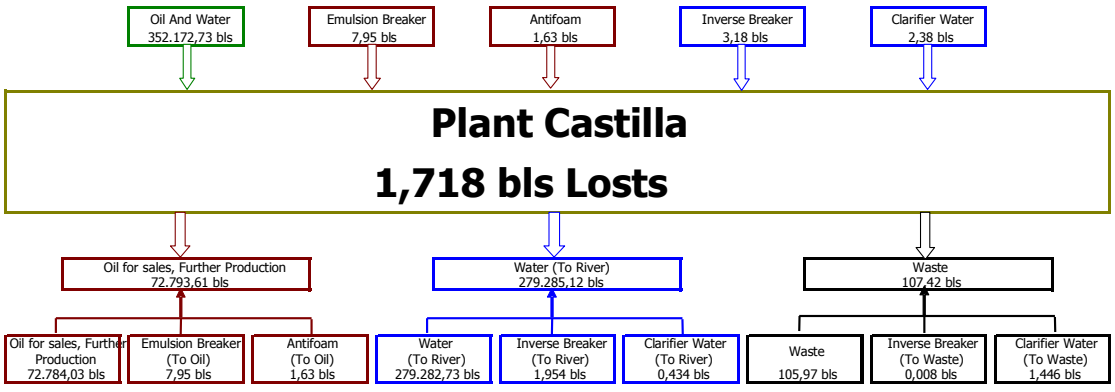
Variables measured in fields to monitor the parameters in quality assurance for the chemical treatment are:

1. BS&W: Content of water in sold oil. The operative window has a range between 0-0,8%.If this parameter is not fulfilled ,the quality system gives a non conformity and it is possible that the oil will not be received and there maybe sanctions.

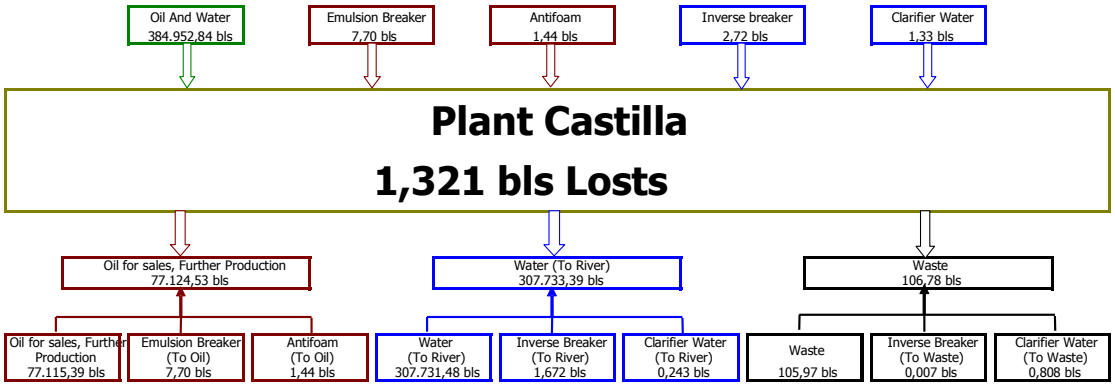
2. Oil content in served water: this parameter measures the oil present in the final water. The operative window allowed for this variable is 0-3 ppm. This is a crucial parameter because the good performance of a field is measured with this indicator.

3. Suspended solids in served water: this indicator measures the quality of the final water for suspended solids. The operative window is a range between 0-3 ppm .

Situation Before Chemical Leasing:



Situation After Chemical Leasing:



Economical Benefits

1. DHC0107: Avoiding damage associated to the chemical waste within the process.

Benefits:

- Impact the total cost associated to the losses in production due to the intervention in wells and the inhibition of the brines.
- Results in labs have shown that a high compatibility between the K1 formation (hearths tests) and the brines (KCl, mutual solvent (EC9610A) and bactericide surfactant).

Total impact in the cost of the operation: (TCO): US$ 1.074.000

2. **OIL0207: Simplifying the logistics of the operation; injecting just one Emultion Breaker EB in both fields (Castilla and Chichimene)**

Benefits:

- Bottle tests have shown and important improvement in the dehydration process in all the fields but is expecting a better performance in the overflow of the¨Gun Barrel¨, storage tanks and the oil line.
- The product will be elaborated in a larger scale, so the production storage and pumping systems costs will decrease. Savings could be almost US 35000 per year and a 10% in total cost will be expected.

Total impact in the total cost of the operation TCO : US$ 35.000

3. WAT0108: Dilution of the polymer with a maturation time

Benefits:

- Reduction in the Polymer EC6019A consumption
- Reduction of the costs in the treatment process is almost 20% of the savings and this is a remarkable fact because this is the second product used the most in the plant.
- Reduction in the residues by the Polymer present in stabilization pools and the served waters.
- Reduction of oils and greases present in the cooling towers.
- Reduction of the costs due to the recovery of the oils in pools and the prolongation of the time to clean and realize the maintenance of the pools and cooling towers.
- Reduction in the environmental impact in served water

Impact in the Total Cost of the Operation TCO: US$ 263.000

4. WAT0208: Measurement of the quality parameters of the water in real time.

Benefits:

- Installing the flow meters in line for the systems.
- Making the flow diagrams and energy- mass balances
- Execution of the operation in the terms of security and continuity within the operations.
- Bottle tests with several types of process conditions.
- Creation of the mobile labs.
- Creation of work for the people (lab jobs)
- Vanguard technology in all the stages of the process.
- Starting the tests in all the fields.
- Adjustment of the yields for the equipments.
- UIT all the monitoring process, it expects that all the flow meters and the lab tests be more controllable and Ecopetrol is looking with this partner to reach optimizations up to 3% of the consumption compared to 2007 without affecting the quality parameters. This reduction is equivalent to US 40.000 of USD 1.392.894

Impact in the Total Cost of the Operation TCO : US$ 394.000

Cost savings since the beginning of Chemical Leasing : USD 400.000

Fair sharing for both companies.

Freezing Tariff 2008. US$2.000.000

Tariff Adjustment August 2008.	US$ 500.000
Tariff Adjustment August 2009	US$ 300.000
Project Reduction in inverse Broker TCO Castilla and Chichimene fields	US$ 40.000
Project TCO Polymer fedeer	US$ 160.000

Ecopetrol has earned USD 2'170.500 based on these Chemical Leasing activities from January to October 2009. This represents a cost optimization as well. This saving represents almost 18% in reductions compared with the value that this company would pay in a traditional model.

(pay per kilo of product). Based on the fact that Net Present Value is the model that Ecopetrol always uses for the suppliers, a big part of this benefit is achieved in the optimization of the dosage.

Environmental Benefits:

Reduction in drums used for the transportation and storage of the chemical products from the plant to the application points; the optimization of the supply in the field with a quick capacity of response in contingencies, and reductions in accidents due to the minor travels carried out with these products.

- The number of contaminated drums of chemicals has been reduced due to the optimization of the consumption that Ecopetrol used in field and due to the change in the presentation where the products were transported (Bulk Crum Reusable). In 2008 Nalco used 4900 drums for the chemical transport and for the year 2009 only 3500 drums.

- Sub products are not generated in the chemical fabrication due to the methodology that Nalco has implemented (Machination process).

- Reduction in clarifier consumption (Polymer) in Castilla 2 due to the start up of the Polymer Feeder equipment where a perfect mixture is carried out at this moment. 20% of this chemical substance has been reduced in final waters and in the recovered solids.

This alliance in the development has achieved high levels in quality for the served waters in oils and suspended solids even up to 99% in removal when the legal norm is only 80%.

name	classification	output to river before ChL	output to river after ChL	output to waste before ChL	output to waste after ChL
Y300450	Inverse Breaker	1,954	1,671712	0,008	0,006528
EC6019A	Clarifier Water	0,434	0,242725	1,446	0,807975

Social Benefits

- A long term commercial relationship allows assuring the jobs for people involved in technical and commercial issues.
- Risks and idleness coming from chemical substances are roughly reduced
- Economical benefits allow social benefits and better conditions to work

6. CURRENT POTENTIAL AND PIPELINE OF CHEMICAL LEASING CLIENTS

6.1 Promotion of Chemical Leasing

Each enterprise could get the best improvements according to the initial goals of the project. Many technical visits and questions about the process were carried out to evaluate the conditions and potential implementations in ChL.

Among the potential cases developed on 2009 many cases have just started as letter of intent and cooperation agreement between companies with NCPC for the ChL objectives, but now they are implementing some modifications based on successful cases achieved in similar enterprises.

6.2 UNIDO Chemical Leasing Missions to Colombia

Based on the dissemination, for environmental experts and environmental authorities and companies not only as pilot cases but also as new strategic sectors for these new tools of sustainable management.

The workshop has had plenty of new advances coming from the pilot cases and specific strategies to apply the Chemical Leasing toolkit based on the economic benefits and technical analysis.

International experts have shared their knowledge and experiences about Chemical Leasing advances not only in pilot cases but in new sectors which are very interested in this sustainable business model.

A Chemical Leasing team has been working with the public in a panel form with the companies and environmental authorities in order to listen to questions and comments about it, and receive feedback from the most specific answers.

6.3 Steps to be taken in the upcoming project phase

1. Define the next ChL cases to develop during 2010
3. Monitoring the ChL achievements in the pilot cases

4. Define the tools to implement in the next ChL projects not only for Colombia but any other project around the world.
5. Reach implementations in the new companies under the model application
6. Finalize the construction of the ChL national team.

7. Preparation of the Chemical Leasing Printed and Training Material

NCPC built a new poster in 2009 focused on immediate impact over companies, and trying to give a message about the direct relation with the sustainable chemical management.

New Brochure developed for the international and national meetings during 2009: