



# **PASSENGER TRANSPORTATION NETWORK (RTP)**

***“BIO-FRIENDLY “  
FUEL COMBUSTION CATALYST***



## INTRODUCTION

This document contains the results obtained from the tests of the Bio-Friendly Fuel catalyst, which have been carried out through a Project implemented by D.F.'s Passenger Transportation Network (RTP) in Mexico.

These tests demonstrated catalyst's efficiency in the reduction of pollutant emissions (opacity) as well as fuel economy, less refill oil consumption and less engine wear.

Due to the results obtained in the tests, it has been decided by RTP to add the Bio-Friendly catalyst to all the buses of their fleet, because it fulfills all the requirements concerning the reduction of pollutant emissions.

The corresponding Test Protocol details all the activities carried out by the different organizations that participated in the project, like experts from the Chemistry Faculty of the National Autonomous University of Mexico (UNAM), Cultura Ecológica - ECOCOM (supplier), D.F.'s Environment Ministry and RTP.



## BACKGROUND

The **Bio-Friendly** Fuel catalyst was tested in 20 engines, 10 GMC and 10 Mercedes Benz. In four of those 20, the percentage of useful life was of 10% approximately, and in this case the objective of the tests was to determine the possibility of secondary effects like: excessive wear of the engine, fast deterioration of useful life of the engine or any other effect that could affect their mechanical conditions.

The objective of these tests was to have truthful , efficient and timely information about the behavior of the engines treated with the catalyst, the benefits and possible problems.

The units in which the test were carried out, have been selected based on the analysis of those buses which were frequently returned form their rout to the garage.

The activities and tests have been carried out in steps in order to avoid drastic impact on the earnings.

## **GENERAL OBJECTIVE**

- To reduce the emissions of pollutants of D.F.'s RTP buses, using an efficient product that could be added directly to the dispatch tanks.

## **SPECIFIC OBJECTIVES**

- Reduce the emission of pollutants
- Fulfillment of the ecological standards
- Reduce refill oil consumption
- Better fuel efficiency

## DEVELOPMENT

### ACTIVITIES

#### NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO (UNAM)

1. Eduardo Marambio, professor of the Chemical Faculty of UNAM, carried out the following activities:
  - a) Deliver the catalyst
  - b) Supply the necessary accessories for oil samples
  - c) Attainment of oil samples and send them to TITAN Laboratories (Denver, U.S.A.) to be analyzed
  - d) Set daily the catalyst in the fuel tanks of the 20 selected buses
  - e) Control catalyst's consumption
  - f) Register kilometers traveled and fuel consumption
  - g) Report any abnormalities, both in time and form
  - h) Prepare and send to the Technical Direction a weekly report

## **D.F.'s ENVIRONMENT MINISTRY**

1. Donation of 127.5 liters of catalyst, enough for 660 buses during one month (continuous days)
2. Designate the Official Verification Center for the measurement of emissions of pollutants

## **PASSENGERS TRANSPORTATION NETWORK (RTP)**

1. Analysis of the service files in order to select 20 buses
2. Diagnosis of the engines (closed) to determine mechanical and operational conditions of each bus before the test
3. Preparation of the preliminary project and the test protocol
4. Follow-up the activities specified in the project
5. Control and registry of the advances and deviations
6. Registry of problems and its solutions
7. Prepare a preliminary report 30 days after initiating the test protocol
8. Prepare a final report 60 days after the utilization of the catalyst

## STRATEGIES

Supervision and control of the correct application and dosage of the catalyst

Supervision and control of the mechanical conditions of the tested buses

Monitoring and registry of fuel consumption and lubricant's refill

Registry of kilometers traveled by each unit (bus)

Supervision and control of the appropriate capture of oil samples

## RESULTS

1. Reduction of pollutant emissions (opacity) (see graph)

2. Fuel economy (see graph)

3. Reduction of refill oil consumption (see graph)

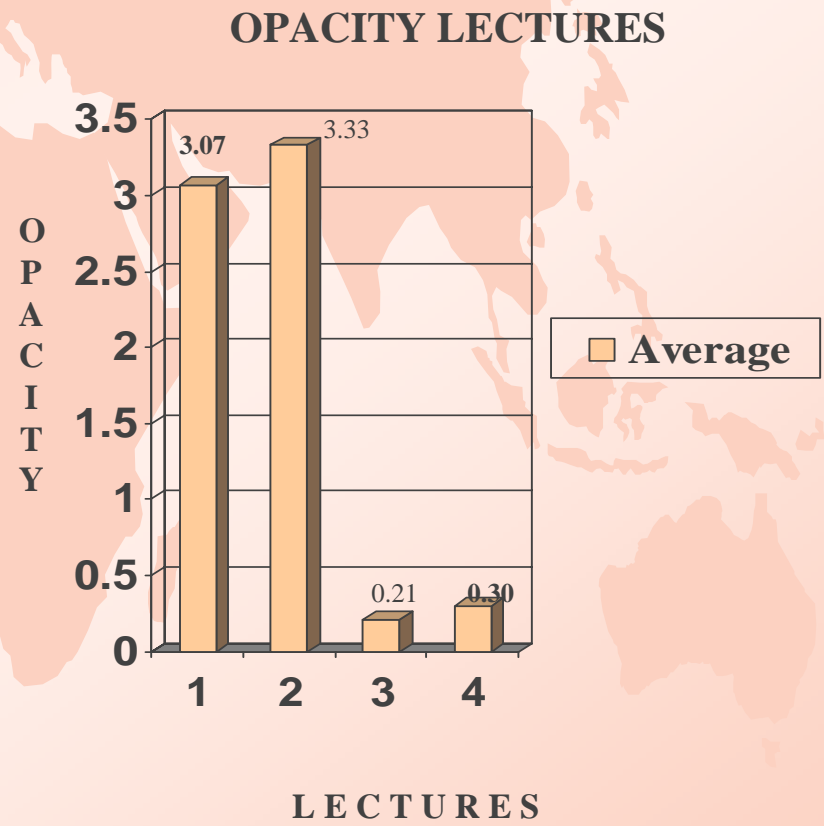
4. Determine useful life of engine's oil



# OPACITY LECTURES

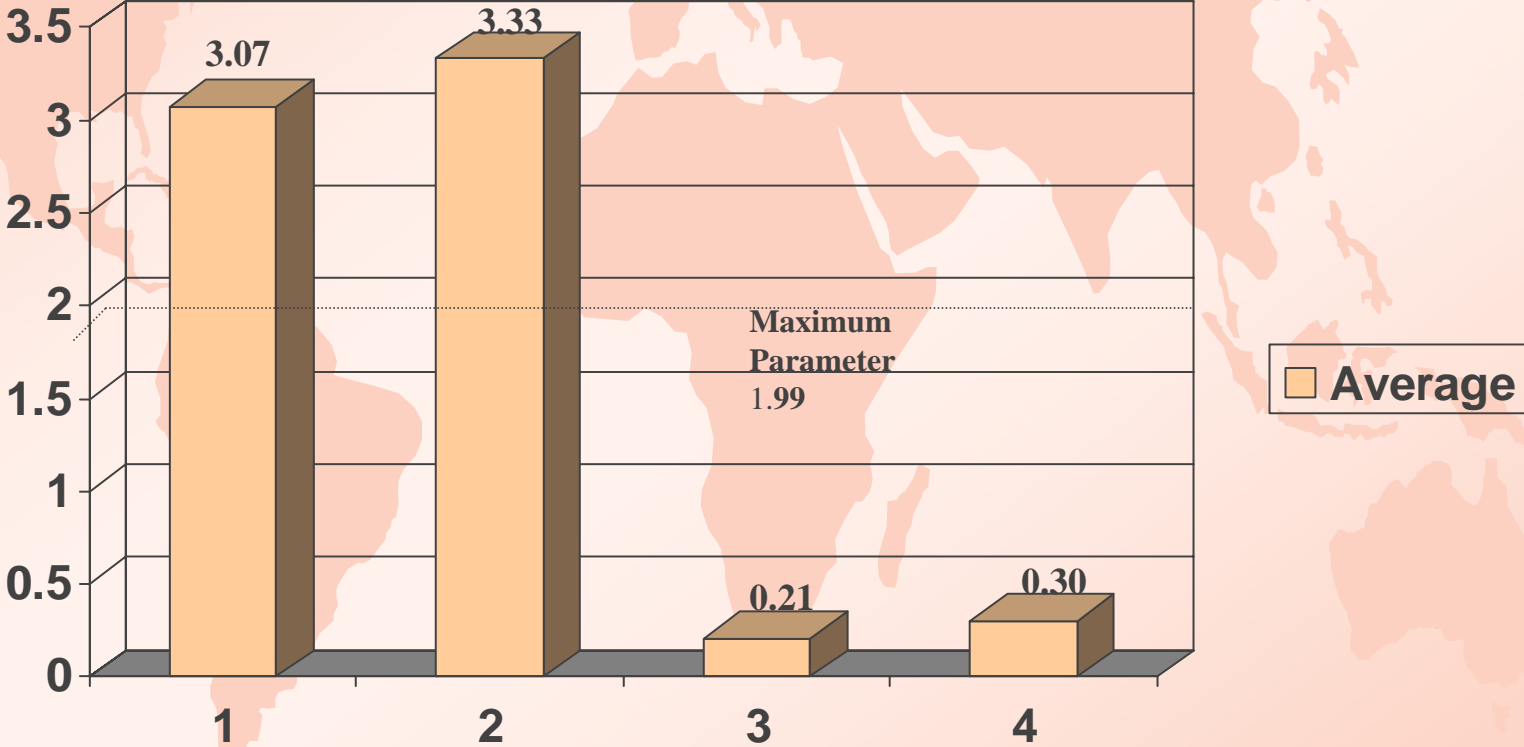
## ACCORDING TO ENVIRONMENTAL STANDARDS

ECO No.	LEC. 1	LEC. 2	LEC. 3	LEC. 4
08-025	3.43	3.47	0.1	0.06
08-028	3.19	3.16	0.12	0.2
08-029	2.11	2.65	0.17	0.35
08-044	3.22	3.51	0.02	0.43
08-050	2.53	2021	0.14	0.33
08-053	2.24	3.48	0.1	0.28
08-072	2.47	3.48	0.25	0.26
08-077	3.33	3.21	0.15	0.41
08-079	3.16	3.47	0.23	0.59
08-102	3.61	3.99	1.42	0.81
08-103	3.22	3.48	0.26	0.31
08-105	3.49	4	250	0.01
08-111	3.05	3.19	0.18	0.14
08-116	2.47	3.21	0.28	0.33
08-117	3.49	4	270	0.27
08-119	4	3.07	0.13	0.32
08-127	3.15	3.58	0.15	0.11
08-130	3.13	3.12	250	0.11
08-150	2.93	3.07	0.04	0.19
08-169	3.23	3.36	0.36	0.57
Total:20	61.45	66.62	4.1	5.97
<b>Promedio</b>	<b>3.07</b>	<b>3.33</b>	<b>0.21</b>	<b>0.3</b>



# OPACITY LECTURES

OPACITY



LECTURES

# DIESEL CONSUMPTION

Liters

3338

3461

2371

3500

3000

2500

2000

1500

1000

500

0

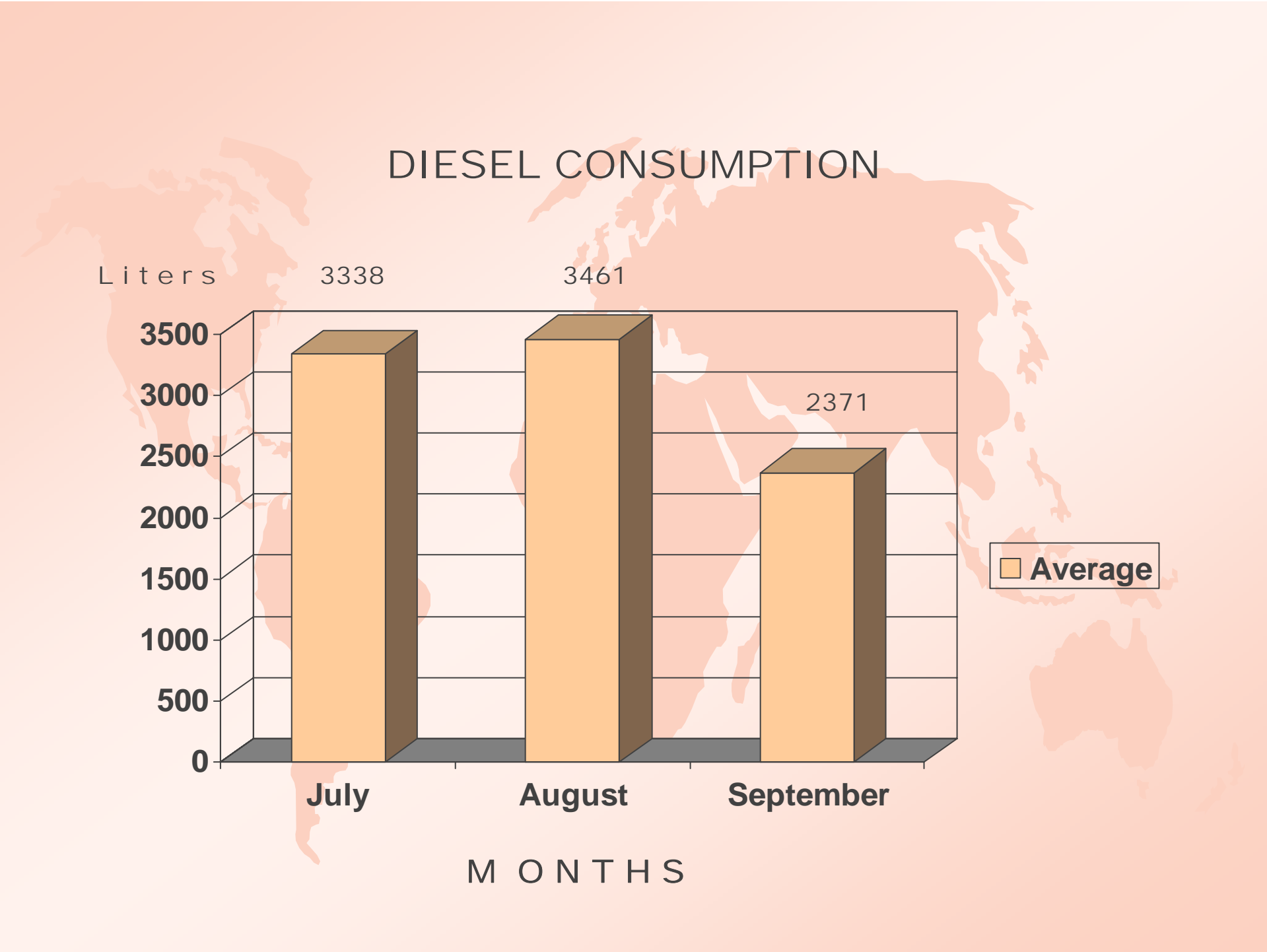
July

August

September

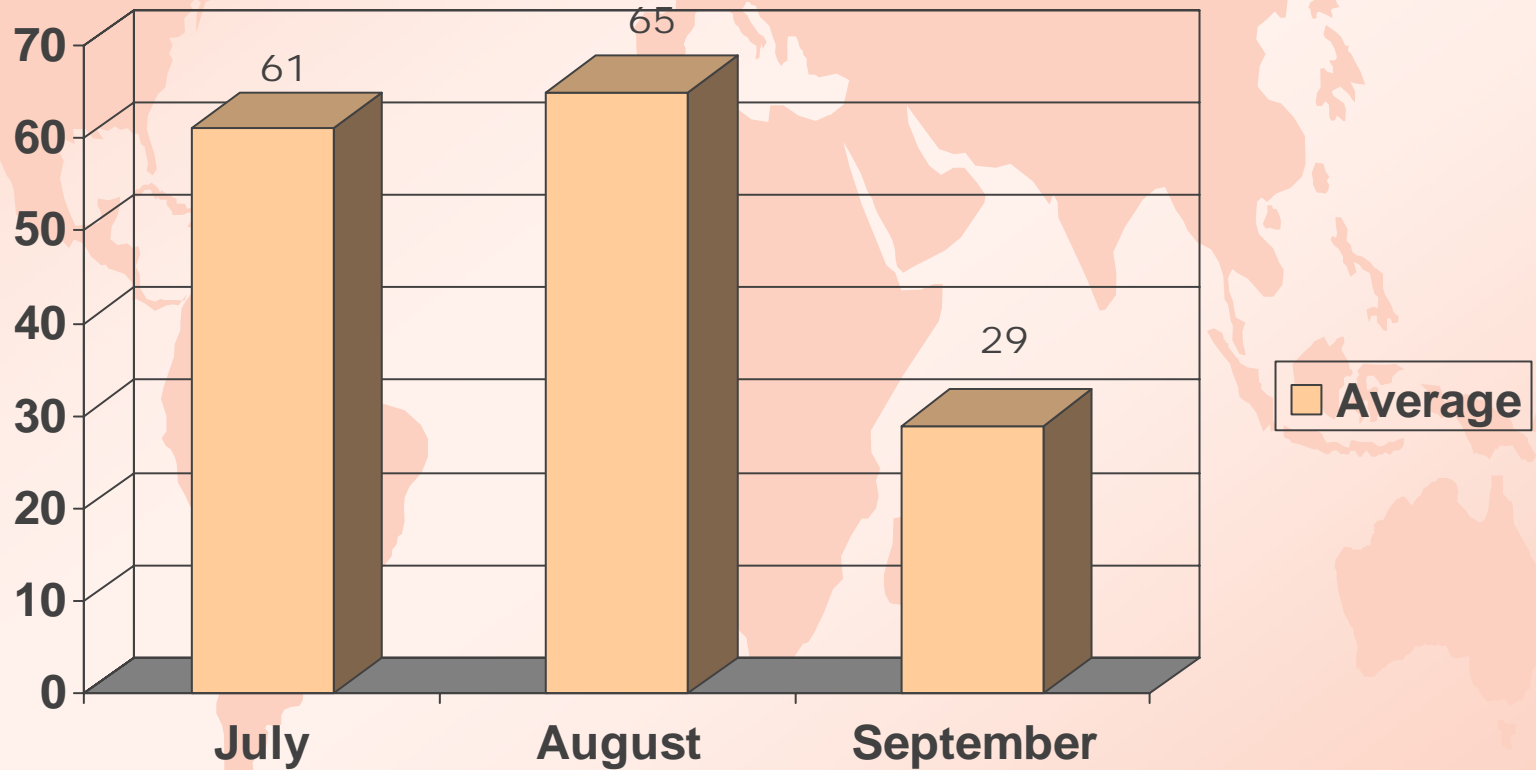
Average

M O N T H S



# OIL CONSUMPTION

Liters



M O N T H S

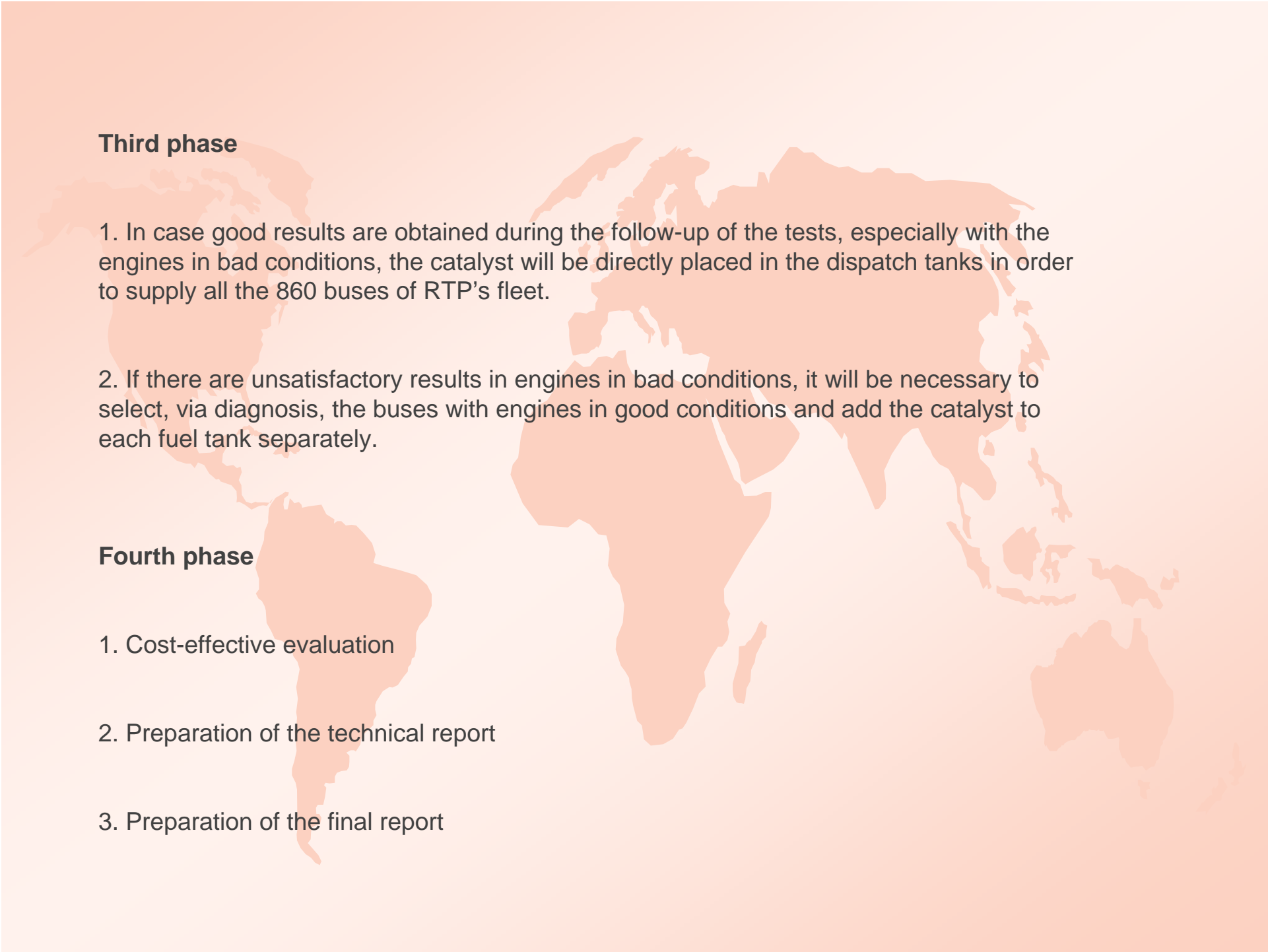
## PLANNING

### First phase

1. Select 20 buses, 10 Mercedes Benz and 10 GMC. Two engines of each type with an almost finished useful life, and the other 16 in normal operating conditions. Basis for the selection are:
  - a) Refill oil consumption
  - b) Date of the last major repair of the engine
2. Preventive service was provided to the 20 buses in order to repair leaks or escapes, failures, measure of compression and counterpressure of exhaust tests; all the above to assure the normal functioning of the buses.
3. Installation of hubodometers to control the kilometers traveled and fast connections (valves) to obtain oil samples.
4. Measurement of pollutant emissions.

### Second phase

1. An exhaustive follow-up of the 20 buses during 15 continuous days, with special attention to those buses with engines in bad conditions, because if the catalyst accelerated their deterioration , it should be used only in engines in good conditions.



### Third phase

1. In case good results are obtained during the follow-up of the tests, especially with the engines in bad conditions, the catalyst will be directly placed in the dispatch tanks in order to supply all the 860 buses of RTP's fleet.
2. If there are unsatisfactory results in engines in bad conditions, it will be necessary to select, via diagnosis, the buses with engines in good conditions and add the catalyst to each fuel tank separately.

### Fourth phase

1. Cost-effective evaluation
2. Preparation of the technical report
3. Preparation of the final report



## PROFILE

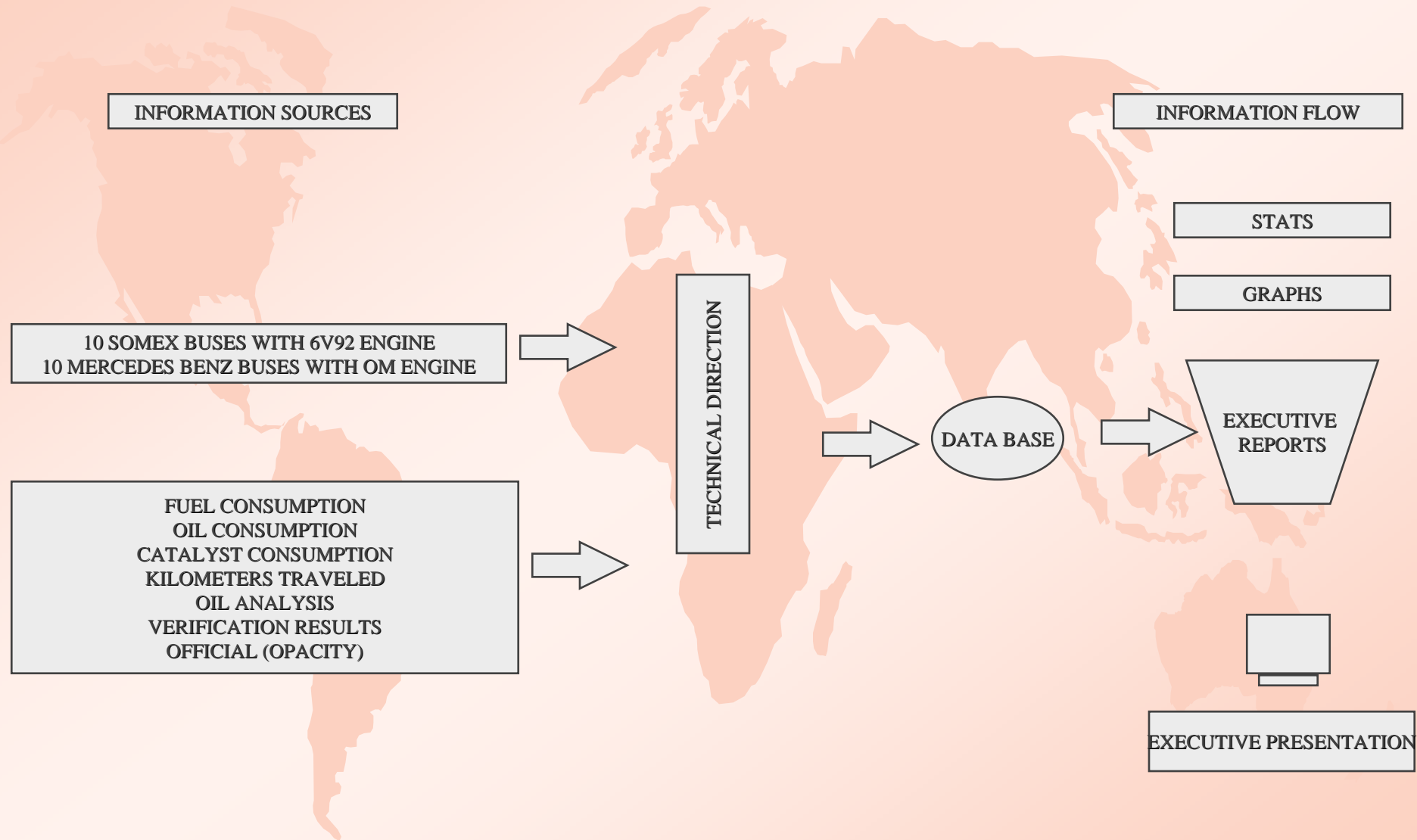
BIO-FRIENDLY's fuel catalyst is technically a unique liquid-based, homogeneous combustion catalyst that is biodegradable and can be supplied in the medium of purified water or alcohol. It is a proprietary catalyst that is processed in such a manner so as to lower the excitation level required to bring about combustion of the fuel to which it is added. This enables the fuel to more easily and completely burn, thus reducing emissions while burning away the buildup of carbon deposits within the engine and improving fuel economy.

Bio-Friendly does not generate any kind of secondary effects nor harmful pollutants, not to human kind neither to Mexico City's air.

The catalyst-fuel proportion is: one ml of catalyst per 20 liters of fuel, which makes it a very attractive product from the economic perspective.

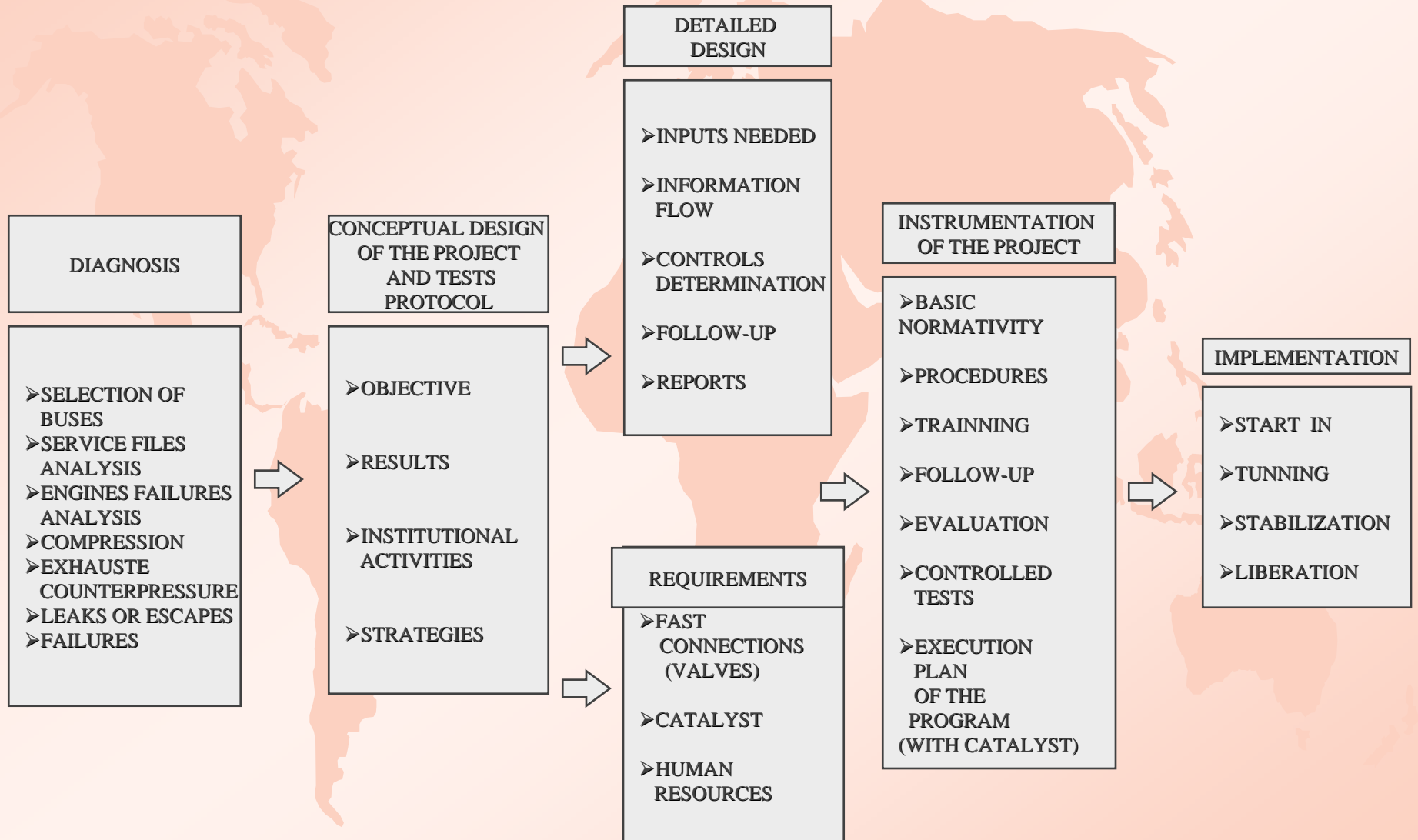
This catalyst had never been tested in buses as old as RTP's, in a city above the sea level as high as Mexico City and with such a high concentration of pollutants in the air, that is why the follow-up is so important to UNAM's Chemistry Faculty and RTP, and the expected results will be proven by exhaustive tests for the first time.

# INFORMATION FLOW





# METHODOLOGY





## REQUESTED INFORMATION

1. Results of the measurement of pollutants' emissions
2. Results of the analysis of the oil used in the engines
3. Registry of kilometers traveled
4. Fuel consumption
5. Refill oil consumption
6. Catalyst consumption
7. Information about fuel and refill oil consumption during July and August as a parameter.

## **BENEFITS**

1. To supply information about the efficiency and effectiveness of a product that helps to prevent air pollution
2. Follow-up and evaluate the most important substantive activities for the dejection of the emission of pollutants
3. Trustfulness in the results obtained
4. Implementation of a permanent program of “additivation” for the improvement of the air quality
5. Improve RTP’s public image or public perception
6. Diminishing of operational costs



## DATA BASE

A data base for the control of information generated during the development of the project has been prepared, containing the following issues:

1. Kilometers traveled by each bus
2. Consumption of refill lubricant
3. Fuel consumption
4. Results of the measurement of pollutant emissions
5. Results of the analysis of the oil used in the engines
6. Catalyst consumption per bus
7. Fuel and oil consumption during July and August



## TODAY'S SITUATION

The catalyst was supplied for the first time in the dispatch tanks on October 15, 2000, after training the Supplies Area personnel of each operative module.

For December 2000, January and February 2001, it was requested the necessary amount of catalyst, considering that during these months the greenhouse gas effect causes higher levels of pollution.

The 127.5 liters of catalyst necessary for the whole fleet for September, were purchased by RTP.

The catalyst for October was donated by D.F.'s Environment Ministry through its General Direction for the control and prevention of contamination.

Today, the "additivation" program is being implemented in all RTP's buses.

## **ACHIEVEMENTS**

- 1. An important decrease in pollutant emissions**
- 2. Fuel economy**
- 3. During November, December and January there were no environmental legal penalties for RTP's buses**
- 4. Abatement of internal wear of the engines**
- 5. More efficient operation of the units (buses)**
- 6. To be the first public transportation organization that truly contributes to the betterment of Mexico City's air quality**

## NEXT PHASE

The opacity (average of solid particles contained in smoke) was measured every two weeks during 60 days, starting the day when the catalyst was supplied. After the measurement it was observed an important decrease of the opacity.

This parameter is not the only one to worry about, but also the acidity produced by the gases during combustion. These gases were measured only once because the Official Verification Centers do not have the required equipment to do so.

In regard of this fact and considering the importance of measuring the acidity of gases, it is already agreed with ITAL-DIESEL, an enterprise that counts with that kind of equipment, to carry out the following activities:

1. Selection of 10 buses which are in similar operational conditions as the 20 of the first sample
2. Measuring opacity and gases before changing oil and filter
3. Change oil and filter
4. Measure opacity and gases
5. Interrupt the “additivation” to those buses
6. 15 days after the interruption, measure the gases again
7. Obtain an oil sample
8. Repeat numbers 6 and 7 every 15 days during 45 days, in order to obtain a parameter in respect of acidity and opacity of gases.
9. After the 45 days, add the catalyst again and repeat numbers 2, 3, 4 and 7
10. Follow-up numbers 2, 3, 4 and 7, during 60 continuous days
11. Prepare the final report

## NEXT PHASE



The BIO-FRIENDLY catalyst has been incipiently tested in gasoline engines, fuel with high content of MIBE, a very harming chemical substance for living organisms.

Due to this reason, RTP will carry out the test protocol for 20 vehicles with gasoline engines.

The test will last 60 days, and the activities to be carried out are detailed in the corresponding preliminary project and protocol.