

5. Waste management concept – Santa Cruz

5.1 Optimization of the waste management concept on Galapagos

In the following one can see a short overview off all of the activities which have been carried out within March 2002 until March 2003 on Galapagos Island.

- The existing collecting system and the treatment of piles and used batteries of the city was re-designed and improved. The experiments with grinded glass as construction material in the production of paving stones started. The results like the resistance durability e.g. is measured and recorded.
- The total quantity of produced oil was calculated and a concept for a new and more efficient collecting and safer transport system was developed.
- At the end of September 2002 an International Symposium and Workshop have been carried out to facilitate the exchange of experience between all of the experts of the different countries.

5.1.1 System of collection, transport and storage of used batteries

The used batteries which are sent to the place of final deposition without a treatment in the Island Santa Cruz represent a constant source of contamination of the soil, water and in the case of incineration of the atmosphere too, affecting the health of people and the surrounding environment.



Picture 5.1: Used batteries found in the place of final deposition

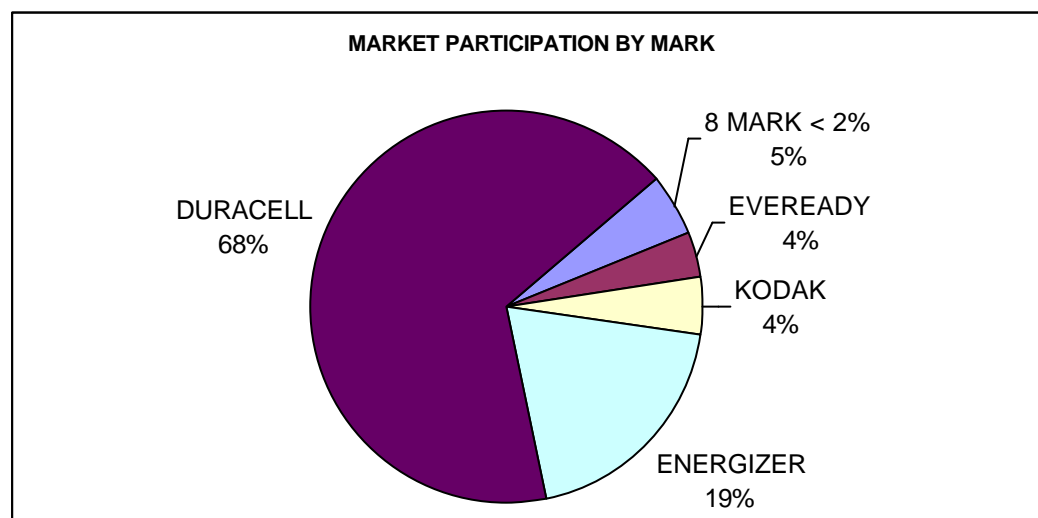
In the case of Santa Cruz the contamination of the phreatic mantel of Puerto Ayora's city is the most vulnerable because, this water resource lies exactly under the human establishments and it is where the biggest effects of contamination take place with regard to used batteries.

It was necessary to get to know the data of quantity, places of commerce, types and participation in the market of the different marks to plan and to develop a campaign of effective gathering.

Table 5.1: Quantity of batteries in stock in Puerto Ayora for type and its marks

Quantity of piles in stock in Puerto Ayora for type and it marks

| No. | mark | 123 | 28A | 9.V | A23 | AA | AAA | C | CR2 | D | DL | KL5 | TOTAL | % |
|-----|-----------|-----|-----|-----|-----|------|-----|------|-----|-----|----|-----|-------|------|
| 1 | GP | | | 1 | | | | | | | | | 1 | 0,0 |
| 2 | RAYOVAC | | | | | 8 | | | | | | | 8 | 0,2 |
| 3 | KINCELL | | | 9 | | 2 | | | | 4 | | | 15 | 0,3 |
| 4 | PANASONIC | | | | | 22 | | | | | | | 22 | 0,4 |
| 5 | DURAVEC | | | | | 24 | | | | | | | 24 | 0,5 |
| 6 | DOUVACELL | | | | | 26 | | | | | | | 26 | 0,5 |
| 7 | POWERCELL | | | | | | 60 | | | | | | 60 | 1,2 |
| 8 | SONY | | | 10 | | 32 | 58 | | | | | | 100 | 2,0 |
| 9 | EVEREADY | | | | | 105 | 20 | | | 71 | | | 196 | 3,9 |
| 10 | KODAK | 21 | 6 | | 4 | 48 | 104 | | 24 | | | 12 | 219 | 4,3 |
| 11 | ENERGIZER | | | 447 | | 60 | 185 | 220 | | 66 | | | 978 | 19,4 |
| 12 | DURACELL | | | 126 | | 1013 | 559 | 982 | | 720 | 2 | | 3402 | 67,4 |
| | TOTAL | 21 | 6 | 593 | 4 | 1340 | 986 | 1202 | 24 | 861 | 2 | 12 | 5051 | 100 |



Picture 5.2: Market participation of each mark

Source: Investigations carried out by the Municipality of Santa Cruz, 2002-2003

5.1.1.1 Collection and transport campaign

The campaign consisted on the following points:

1. Determination of the commercial locations and institutions with relevant consumption

To determine the collecting points an evaluation of the biggest battery consumers and their location has been carried out. After this evaluation two relevant groups could be determined:

Institutions

The Galapagos National Park, the Charles Darwin Research Station and the fishing Cooperatives are the biggest battery consumers at local level.

Stores

The stores do have a central position with regard to the commercializing of batteries and the possibility for carrying out environmental capacitating campaigns for a better withdrawal of used batteries.

Table 5.2: Number of batteries in stock for store and type

NÚMERO DE PILAS EN STOCK POR LOCAL COMERCIAL Y TIPO

| No. | LOCAL | 123 | 28A | 9.V | A23 | AA | AAA | C | CR2 | D | DL | KL5 | TOTAL | % |
|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|-----|-------|------|
| 1 | BODEGA BLANCA | | | | | 250 | 250 | 250 | | 250 | | | 1000 | 19,8 |
| 2 | COMERCIAL TUNGURAHUA | | | 10 | | 264 | | 336 | | 144 | | | 754 | 14,9 |
| 3 | SUPERMARKET PROINSULAR | | | 392 | | | 109 | 28 | | 50 | | | 579 | 11,5 |
| 4 | COMERCIAL ROCIO I | | | 96 | | 48 | 48 | 120 | | 48 | | | 360 | 7,1 |
| 5 | GUITIG TESALIA | | | | | 200 | 20 | 46 | | 24 | | | 290 | 5,7 |
| 6 | PALACIO DE LAS PILAS | | | 6 | | 20 | 84 | 20 | | 42 | | | 172 | 3,4 |
| 7 | VARIIDADES | | | 15 | | 54 | 16 | 58 | | 6 | | | 149 | 2,9 |
| 8 | TIENDA | | | | | 48 | | 48 | | 48 | | | 144 | 2,9 |
| 9 | GALA COLOR | | | 8 | | 24 | 100 | | 10 | | | | 142 | 2,8 |
| 10 | MINI MARQUET MIRAFLORES | | | | | 24 | 54 | 16 | | 44 | | | 138 | 2,7 |
| 11 | TROPIDUROS | | | 9 | | | 76 | 22 | | 10 | | | 117 | 2,3 |
| 12 | NACHITA | | | | | 40 | 30 | | | 32 | | | 102 | 2,0 |
| 13 | TIENDA GISELITA | | | | | 8 | | 64 | | 12 | | | 84 | 1,7 |
| 14 | GRAN REY | | | | | 11 | 13 | 30 | | 27 | | | 81 | 1,6 |
| 15 | COMERCIAL ROCIO II | | | 20 | | 16 | 16 | | | 20 | | | 72 | 1,4 |

2. Implementation of environmental education & communication campaigns

Message of the campaign: “Used batteries which are thrown into the garbage will contaminate the environment and can cause physical illness to the human being.”

Target group: People who live in Puerto Ayora and consume batteries for their different activities.

Communication tool: Posters, Stickers in the plastic recipients.



Picture 5.3: Poster campaign for collection system for used batteries



Picture 5.4: Information campaign during agricultural fare

3. Installation of plastic recipients in the places of frequent purchase

In each one of 30 stores one plastic recipient for the collection was installed and 10 medium recipients were installed in the institutions with the highest consumption.



Picture 5.5: Delivery of recipients in stores and signature of commitment

4. Installation of a temporary storage center

At the moment the used batteries are temporarily deposited in the Center of Acopio Fabricio Valverde, which is located at km 4 off the road to “Isla Baltra”. Later the used batteries will be shipped to the city of Guayaquil and accepted for further treatment by the company ENERGIZER.

Presently approximately 1,700 used batteries have been collected which represents approx. 119 kg.



Picture 5.6: Deposited batteries in the Fabricio Valverde Center

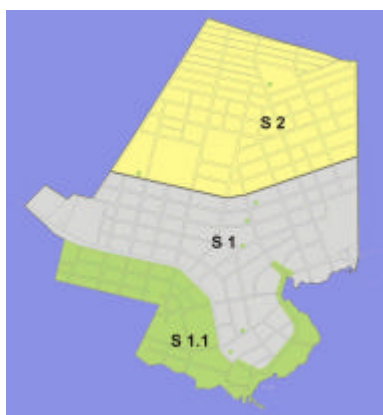
5.1.2 Reuse of glass

Until March 2002 the Municipality worked to improve the operating system for the collection of recyclable materials and the implementation of appropriate equipment to crush the glass. The glass is needed for the production of paving stones with the block-making machinery and is collected in the city.

The following strategies have been implemented to improve the production of paving stones:

1. Improvement of the collection of the recyclable materials

In May 2002 a resolution "Ecological Area" concerning the re-use of recyclable material was declared by the Municipality affecting the neighborhoods La Alborada, Las Ninfas and Pampas coloradas, to implement a pilot plan for the selective collection of recyclable materials. In a first step the Municipality of Santa Cruz contracted an additional vehicle to recover the recyclable material of this area.



Picture 5.7: Area S 1.1 "Ecological area" City of Puerto Ayora

The quantity of recyclable material which is sent to Fabricio Valverde center increased notably after the ecological area was included in the collection system plan.

Table 5.3: Quantity of material [kg] sent to the Fabricio Valverde center

| | 2002 | | | | | | | | | | | Total | % |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | | |
| PLASTIC | 258 | 142 | 135 | 243 | 487 | 355 | 277 | 299 | 226 | 449 | 431 | 3,564 | 4,72 |
| CARDBOARD | 3,513 | 3,144 | 2,714 | 1,895 | 3,455 | 3,934 | 3,964 | 3,578 | 3,035 | 3,921 | 4,450 | 41,040 | 54,39 |
| GLASS | 1,967 | 1,709 | 1,794 | 1,330 | 3,357 | 2,338 | 2,530 | 2,315 | 2,126 | 3,653 | 4,207 | 27,488 | 36,43 |
| PAPER | 321 | 190 | 215 | 222 | 370 | 212 | 328 | 321 | 357 | 258 | 339 | 3,366 | 4,46 |
| TOTAL | 6,058 | 5,185 | 4,858 | 3,690 | 7,668 | 6,839 | 7,098 | 6,512 | 5,744 | 8,282 | 9,427 | 75,458 | 100,00 |

2. Implementation of Fabricio Valverde center

In April 2002 a glass crushing machine was purchased on the part of the Fundación Galápagos Ecuador. This machine has a per hour crushing capacity of approx. 200 kg glass.



Picture 5.8: Installation and operation of the glass mill

Once crushed the material is temporarily accumulated until it is used as an aggregate in the making of paving stones.



Picture 5.9: Storage of crushed glass and crushing mechanism

3. Production of paving stones

For the production of paving stones besides glass the following equipment, material and tools are necessary:

Equipment:

- Horizontal block-making (paving stones) machine of vibration and pressure
- Different molds for different sizes of paving stones
- Wooden base forged of a size of 64 cm x 50 cm.

Materials:

- Thick Sand
- Fine Sand
- Cement
- Fine stones
- Pigment
- Fine crushed glass
- Thick crushed glass
- Diesel

Tools:

- Shovel
- Brush
- Hammers
- A metallic rule

The conclusions of the paving stones production with glass are the following ones:

- One man can theoretically elaborate up to 300 paving stones in one day of 8 hours.
- It is suggested to manufacture the paving stones in two parts. In the first one with glass and cement and then in the next one to stuff the remaining 50% with normal mortar.
- It is recommended using white cement for the front face.
- It is recommended not polishing the front face with abrasive materials because the glass will get opaque. For further manufacturing of the paving stone it is instead recommended to do this with a liquid 60 minutes after the production process.



Picture 5.10: Block making machine and manufactured blocks

The obtained result with the production of paving stones is high. The Municipality of Santa Cruz will use them for the remodeling of the main roads and in the construction of sidewalks where three colors of manufactured paving stones will be used (green, white and coffee).

Additionally there are private people who requested this product for the construction of house entrances.

While the writing of this report the installed capacity in the Fabricio Valverde center was something about 200 paving stones daily. This production capacity hasn't reached its maximum.

5.1.3 Results of the study about the amount of used oil on Santa Cruz

The used oil still has a high contamination level in the Galapagos Islands. Especially on Santa Cruz Island, where most of the tourist ships are anchoring and in comparison to the other Islands of Galapagos, where lives most of the population (12,000 people).



Picture 5.11: Oil contamination in the Electric Company Area - Puerto Ayora

From May 2000 on the private company RELUGAL passes by and picks up the used oil of tourism ships and some of the institutions. According to the provided data of this company, they have recovered approx. 52,136 gallons (1 gallon = approx. 3,8 l) of used oil until November 2002.

Presently and due to the lack of better appropriate storage areas, the used oil is deposited in a storing center which is located in the residence of the proprietor of RELUGAL.



Picture 5.12: Center of current storing of used oils

To improve the management system of used oil it was necessary to carry out a study to determine the exact quantity of used oil which is generated in the canton and to cross-check it with the one which is picked up by RELUGAL.

Analysis method

To determine the quantity of used oil which is generated in the Canton Santa Cruz the number of combustion motors together with their necessary amount of oil for lubrication was estimated. This estimation included the tourist ships that operate from Santa Cruz, the fishing boats and vehicles which are registered in Santa Cruz and the public and private institutions.

The analysis is carried out based on the population's total. The data is obtained from the following sources:

- Lists of tourism ships: Galápagos National Park
- Lists of fishing boats: Galápagos National Park
- Lists of vehicles: Municipality of Santa Cruz
- Public and private institutions: own investigation

Table 5.4: Results of the estimation of the monthly production of used oil

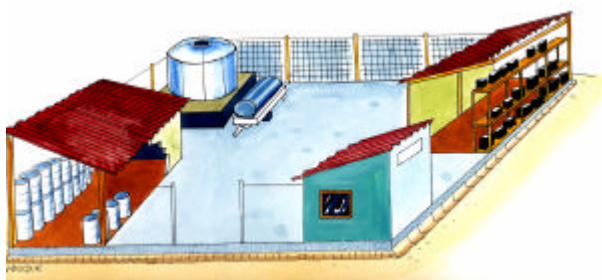
| SECTOR | QUANTITY | GL./MES | % |
|-------------------------|----------|---------|-------|
| TOURISM SHIPS | 53 | 1542,5 | 49,02 |
| VEHICLES | 591 | 782,75 | 24,87 |
| ELECTRIC PLANT | 1 | 600 | 19,07 |
| FISHING BOATS | 113 | 115,5 | 3,67 |
| GALAPAGOS NATIONAL PARK | 1 | 76 | 2,42 |
| OTHER INSTITUTIONS | VARIOUS | 30 | 0,95 |
| TOTAL WASTE OIL | | 3146,75 | 100 |

- Due to this estimation the average monthly collected amount of used oil at the moment is only approx. 52% of the one generated. That means that the collection system for used oil has to be improved.
- The car motor sector has an important participation of 25% of the total generated oil. This evidences a lack of administration to recover the oil coming from this sector.

Proposal for the improvement of the collection system for used oil:



Picture 5.13: Special trailer for oil collection and temporary storage tanks



Picture 5.14: Construction of a storing center outside of the city

5.1.4 International Symposium on Santa Cruz

The work shop Sustainable Waste management for Oceanic Islands was developed according to the established chronogram from the 24th until the 27th of September 2002.

The participants have been:

COLOMBIA: Government San Andrés (1); CORALINA (1)

GERMANY: City of Karlsruhe (1); wat (1)

ECUADOR: Municipality of Santa Cruz; Fundación Galápagos Ecuador, Parque Nacional Galápagos.

INVITED INSTITUTIONS:

Environmental police
Charles Darwin Research Station
Central University of Ecuador
Galapagos National High School

OBJECTIVES OF THE WORK SHOP

- Carrying out of an exchange of experiences and technology among the partners of the project to improve the waste management of the partners Santa Cruz and San Andrés
- Informing of the partners about the current situation and advances of the project and proposal of the waste management in Galapagos

OBTAINED RESULTS OF THE WORK SHOP

- Knowledge about the operative system of waste collection in different countries for deriving new ideas for the selective collection of Galapagos.
- Examination of the environmental educational capacitating work of CORALINA with regard to its transferability to a similar system on Galapagos Islands.
- Exchange of experiences in the re-use of glass as paving stones in Galapagos.
- Exchange of experiences of the German partners in the construction of landfill sites and examination and assessment of the dump area on km 27 via Baltra.
- The discussed information was used for the formulation of a new proposal for the waste management in the Galapagos Islands.



Picture 5.15: Photos from the workshop on Santa Cruz in September 2002

5.1.5 Results of the detailed waste study on Santa Cruz

For an appropriate programming and planning of the waste management it is necessary to know the quantity and composition of waste. For this purpose the "detailed waste characterization in the Canton Santa Cruz" study was carried out.

Objectives of the Study

- Investigation of the total daily quantity of solid waste and determination of the composition in the levels of materials and products in the following sectors:
 - Commercial Area of Puerto Ayora

- Residential Area of Puerto Ayora
- Tourist Crafts
- Bellavista and Santa Rosa village
- Proposal of a system to minimize the quantity of waste, to use the value substances and the elimination of the toxic waste.

Used methodology:

- The study was carried out at km 27 of the road to Baltra in the place of final deposition of waste of the Canton Santa Cruz.
- The waste corresponded to one day of generation and it was deposited outside of the habitual gutter and was weighed later.
- Three individual studies were carried out corresponding to the days 20th of November 2002, 29th of November 2002, and 16th of December 2002.



Picture 5.16: Waste of different sections before the analysis I



Picture 5.17: Waste of different sections before the analysis II



Picture 5.18: Current method of waste dumping in the Canton Santa Cruz

For the determination of weight and volume of the generated waste the waste of each collecting area was completely weighed and then the composition was determined on the base of a 10% random sample.

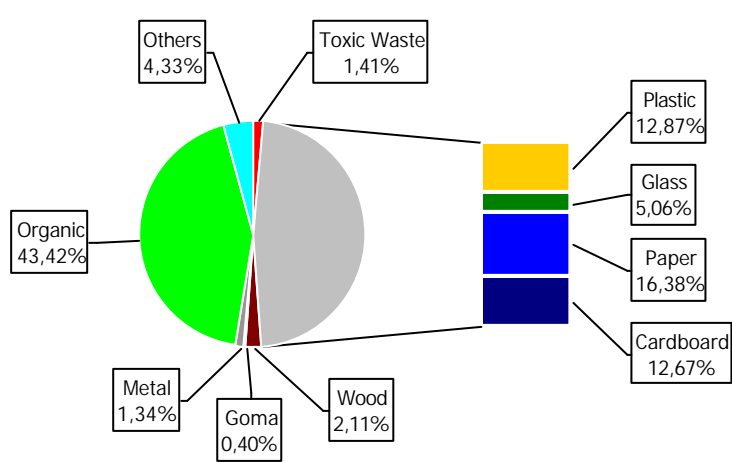


Picture 5.19: Method of weighing and analyzation of the waste

The following Table 5.5 and Picture 5.20 show the results of the waste classification study.

Table 5.5: Results of the quantification of generated waste

| Place | Zona | Total Quantity of waste for person in Santa Cruz | | | Quantity Habitants | | Annual Quantity | | | |
|-----------------|-------------|--|---------------------|----------------|--------------------|--------------|-----------------|---------------------|-----------------------|------------------------|
| | | Greenwaste [kg/day] | Reciclable [kg/day] | Waste [kg/day] | Total [kg/day] | Residents | Tourist Ø year | Quantity [tons./vl] | Quantity [lka/hab/vl] | Quantity [lka/hab/day] |
| | | Bellavista / St.Rosa | | | 427,10 | 427,10 | 1138 | | 155,9 | 136,98 |
| Puerto Ayora | Residencial | 400,00 | | 1380,08 | 1780,08 | 3410 | | 649,7 | 190,53 | 0,52 |
| Puerto Ayora | Comercial | 400,00 | 246,70 | 5373,67 | 6165,73 | 5903 | 193 | 2250,5 | 369,19 | 1,01 |
| | PNG | | | 80,00 | | | | | | |
| | ECCD | | | 65,36 | | | | | | |
| Touristic Boats | | | 101,42 | 753,26 | 854,68 | | 1046 | 312,0 | 298,35 | 0,82 |
| Total | | 800,00 | 348,12 | 8079,47 | 9227,59 | 10451 | 1239 | 3368,1 | 288,13 | 0,79 |



Picture 5.20: Classification of the waste on Santa Cruz

5.1.6 Economical and legal instruments

The biggest legal success obtained in the topic of administration of waste in the Galápagos Islands was the expedition of the REGALMENT FOR THE ADMINISTRATION OF THE WASTE AND RESIDUALS FOR THE GALAPAGOS ISLANDS in December 2002, signed by the President of the Republic of Ecuador, Dr. Gustavo Noboa Bejarano. The most important articles in this expedition are the following:

Art. 2 OBJECTIVES:

- Regulation of the integral administration of waste and residuals, in order to preserve the human health and the atmosphere
- Reduction of the quantity of waste that is generated in all human activities in the Galapagos Islands.
- Involvement of the different institutions in the solution of the problem of contamination by waste and residuals.
- Implementation of the recycling system and sanitary fillers for the populated areas of the Archipiélago.
- Stimulation of the reuse and changes of attitude in the habits of the insular population's and visitor consumption.
- Improvement of the quality of the local population's and visitor life of the islands.

Art. 10 GENERATION AND STORAGE:

a) With regard to the separation of the solid waste at source and the waste storage in appropriate recipients the bins must have the following characteristics:

1. in green colored recipients the organic waste of easy decomposition will be deposited.
2. in black colored recipients the inorganic products and such of a difficult biodegradability like cans, cloths, wood and other products will be deposited.
3. in blue colored recipients the recyclable waste will be deposited, such as e.g. periodic paper, cardboard, plastic, glass and aluminum containers.

RESTRICTIONS

Due to Article 40 the entrance of soda drinks and beer in disposable containers for commercialization to the Galápagos Islands is illegal.

5.1.7 Environmental awareness rising campaigns

This component consists of permanent campaigns, who involve educational institutions, housings and public locations. The work related to the waste includes courses, shops, conferences, works of marionettes, competitions, radio and television management.

Developed activities and obtained results:

Interpretation

1. Pronounced lettering of the entrance to the Fabricio Valverde Center (km 4 via Puerto Ayora - Parroquia Bellavista)
2. Posters of the pilot project of the collecting of recyclable materials in housings inside of the ecological area.



Picture 5.21: Road sign for Fabricio Valverde - center of recyclable materials

Communication

- a) Informative sites in the handmade fair, agricultural fair
- b) Diffusion for the local means of information: radio, television, presses written; on the implementation of the Fabricio Valverde Center with a glass mill. Other activities in coordination with the Communication unit and with the one that attended 100 people approximately.



Picture 5.22: Participation in local fares

Environmental education

- a) Door to door visits by all of the housings of the ecological area indicating the habitants of the place the procedure for the collection, frequencies and doubts.
- b) Amplification of the recycling project to the educational centers of the canton, especially to high and primary schools.



Picture 5.23: Delivery of sacks for the selective collection in the ecological area

Marionettes “Pancho the ball”

This work consisted in a marionette show with the main topic: The recycling whose objective was that the children learn how to separate the garbage from their classrooms. The show was for approximately 1,560 children and 24 functions of marionettes were presented.



Picture 5.24: Show of marionettes presented to children of the town

Painting competition

In the primary school Galo Plaza a painting competition was carried out with the main topic “The Recycling”. The competition was developed in two phases one with 40 students boys and girls and the second directed to teachers with the participation of 12.

Work shop of recycling

A work shop was carried out in the high school “Loma Linda”. The objective of this work shop was the elaboration of recycled paper.

Guided thematic visits to the Fabricio Valverde center:

This activity consists of talks with the teachers from schools and visits of km 27, the Fabricio Valverde center and other places of interest for the recycling. The educational establishments that have participated are the following ones:

- Miguel Ángel Cazares High School
- National Galápagos High School.
- Tomás of Berlanga High School
- San Francisco High School



Picture 5.25: Thematic visit to the Fabricio Valverde center