**From:** Steven Donziger
**To:** Charles Champ
**Sent:** Mon 5/28/2007 3:31:03 AM GMT
**Subject:** Fwd: FOE is on our team RE: exxon valdez 30x

check this out from powers... he claims the 30x larger than the valdez claim is wrong based on this data. i think he is comparing apples to oranges. do u have
any thoughts?

srd

---------- Forwarded message ----------
From: Steven Donziger <sdonziger@gmail.com>
Date: May 27, 2007 10:19 PM
Subject: Fwd: FOE is on our team RE: exxon valdez 30x
To: luis villacreces carvajal <luis_villacreces@hotmail.com>
Cc: " Amaest@aol.com <mailto:Amaest@aol.com> " <amaest@aol.com>

por favor analize este. srd

---------- Forwarded message ----------
From: Bill Powers < bpowers@powersengineering.com
<mailto:bpowers@powersengineering.com> >
Date: May 24, 2007 6:23 PM
Subject: FOE is on our team RE: exxon valdez 30x
To: Steven Donziger < sdonziger@gmail.com <mailto:sdonziger@gmail.com> >
Cc: Atossa Soltani < asoltani@igc.org <mailto:asoltani@igc.org> >,
Simeon Tegel < simeon@amazonwatch.org <mailto:simeon@amazonwatch.org> >,
Kevin Koenig <kevin@amazonwatch.org>, Jennifer Delury Ciplet <
jennifer@amazonwatch.org <mailto:jennifer@amazonwatch.org> >

Brother Steven,

I am an innocent man. I was asked to take a look at the 30x figure. I didn't know who came up with that figure. All I did was look at the 1994 FOE report "Crude Operator" that I got out of the Selva Viva library during one of my trips to the Team Ecuador redoubt in Quito. I photocopied every document out of the library I thought might be useful. The FOE document is explicit: ~19,000,000 gallons lost over time with the produced water in Ecuador oil operations though the early 1990s, approximately 80% associated with operations in Oriente. That works out to about 15,000,000 gallons lost via produced water in Oriente. The Exxon Valdez spilled around 11,000,000 gallons according to the EPA ( http://www.epa.gov/oilspill/exxon.htm
<http://www.epa.gov/oilspill/exxon.htm> ). See p. 15 of the FOE .pdf (p. 31 on page itself), top paragraph:

Below is one of the tables on produced water quality in the FOE report. FOE cites test data from two different test programs (Reyes, 1990, and HBT Agra 1992). The last paragraph on p. 11 of pdf states 19,000 million gallons (19 billion gallons) of produced water was discharged by Texaco during its time in Oriente. That works out to about 60,000 barrels per day of produced water discharged by Texaco over the 20-year life active of the project (1973-1993). That sounds reasonably accurate to me based on what I know of produced water discharge rates in Oriente. DINAMA estimated that average hydrocarbon content in the produced water at 1,000 ppm (0.1%). 0.1% x 19,000 million gallons of produced water = 19 million gallons of hydrocarbons. Given the test data in the FOE report and the test data we have for these types of pits in the Corrientes region of Peru, the 1,000 ppm hydrocarbons assumption looks conservative to me.

FOE is on our team. We should corroborate the pedigree of the "2% crude lost with the produced water" assumption if it is part of the media campaign.

Bill

--
Steven Donziger
212-570-4499 (land)
212-570-9944 (fax)
917-566-2526 (cell)

Steven R. Donziger
Law Offices of Steven R. Donziger, P.C.
245 W. 104th St., #7D
New York, New York 10025
Email: sdonziger@gmail.com <mailto:sdonziger@gmail.com>

--
Steven Donziger
212-570-4499 (land)
212-570-9944 (fax)
917-566-2526 (cell)

Steven R. Donziger
Law Offices of Steven R. Donziger, P.C.
245 W. 104th St., #7D
New York, New York 10025
Email: sdonziger@gmail.com

**image006.gif**
**image003.gif**
**image001.gif**
**1994_Crude Operator_FOE_Ecuador_oil_produced water discussion.pdf**

TEXACO
Doc #12-

FRIENDS of earth

# CRUDE OPERATOR

GAS

The Environmental, Social and Cultural Effects of Texaco Oil Operations in the Tropical Forests of Ecuador

# Crude Operator

## The Environmental, Social and Cultural Effects of Texaco Oil Operations in the Tropical Forests of Ecuador

Friends of the Earth

Friends of the Earth England, Wales and Northern Ireland is one of the UK's leading environmental pressure groups. It campaigns locally, nationally and internationally and provides authoritative information on a wide range of environmental issues.

Friends of the Earth opposes the destruction of the environment but also proposes constructive solutions. It creates pressure for change through mobilizing public opinion and lobbying politicians and industry. It believes in informing and empowering the public, and encourages people to take action through its network of over 300 Local Groups.

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Table of Contents

## Acronyms

| | |
|---|---|
| ARPEL | Latin America State Oil Reciprocal Assistance |
| BOD | Biochemical Oxygen Demand |
| bopd | Barrels of oil per day |
| BPIS | British Petroleum International Services |
| BPM | Best Practicable Means |
| BTX | Benzene, Toluene and Xylene |
| CEPE | Corporacion Estatal Petrolera Ecuatoriana |
| CESR | Centre for Economic and Social Rights |
| COD | Chemical Oxygen Demand |
| COICA | Coordinadora de las Organizaciones Indigenas de la Cuenca Amazonica |
| CONAIE | Confederacion de Organizaciones Indigenas del Ecuador |
| CONFENIAE | Confederacion de Nacionalidades Indigenas de la Amazonia Ecuatoriana |
| CORDAVI | Corporacion de Investigaciones Jurdico-Ecologicas y de Defensa de la Vida |
| DIGEMA | Direccion General de Medio Ambiente |
| DINAMA | Direccion Nacional de Medio Ambiente |
| EQO | Environmental Quality Objective |
| EU | European Union |
| FCUNAE | Federacion de Comunas Union de Natios de la Amazonia Ecuatoriana |
| FoE | Friends of the Earth |
| ITTO | International Tropical Timber Organization |
| IUCN | International Union for the Conservation of Nature and Natural Resources |
| IWT | International Water Tribunal |
| NGO | Non-governmental Organization |
| OPEC | Organization of Petroleum Exporting Countries |
| OPIP | Organizacion de Pueblos Indigenas de Pastaza |
| PAH | Polycyclic Aromatic Hydrocarbon |
| ppm | Parts per million |
| RIVPAC | River Invertebrate Prediction and Classification Scheme |
| SIL | Summer Institute of Linguistics |
| SMA | Subsecretario de Medio Ambiente |
| SOTE | Sistema del Oleoducto Trans Ecuatoriana |
| TPH | Total Petroleum Hydrocarbons |
| TSS | Total Suspended Solids |
| TDS | Total Dissolved Solids |
| UK | United Kingdom |
| USA | United States of America |
| USEPA | United States Environmental Protection Agency |
| WHO | World Health Organization |
| WQO | Water Quality Objective |

In 1992, Texaco pulled out of its oil operations in the Ecuadorian Amazon (the Oriente) amidst growing controversy over the social, cultural and environmental impacts of the oil industry in the region. As lead partner and operator in a consortium with Petroecuador (and previously Gulf), Texaco had opened 16 oil fields, over 300 wells and extracted over a billion barrels of oil from the Oriente. The consortium pioneered oil development in the region.

By the late 1980s, approximately 80 per cent of all Ecuador's oil originated from the concession of the Texaco consortium (commonly referred to as 'Texpet'[1]). However, as operator for the consortium, the company's legacy to the country (and the Amazon in particular) includes environmental degradation, social disruption and cultural disintegration. Various groups within Ecuador have been campaigning for Texaco to clean-up contaminated sites, to repair outdated infrastructure and to adequately compensate affected communities; a clear precedent must be set, placing responsibility for these impacts on the company.

In 1992, after negotiation with the Government of Ecuador, Texpet commissioned an environmental audit of its operations in the country. The purpose of the audit was to identify the environmental impacts of Texpet's operations and measure compliance with environmental regulations between 1964 and 1990. In Friends of the Earth's opinion, the scope, technical criteria and methodology of the audit were seriously flawed. Consultation with affected peoples and non-governmental organizations was non-existent and the social and cultural impacts of Texpet's activities were not addressed. Little attention was given to human health aspects. The technical criteria proposed for the audit were inadequate (see appendix 1). A further weakness was its lack of independence (see pages 46 to 47). The Ecuadorian Congress, with assistance and advice from non-governmental organizations in the country, has also prepared a critique of the audit.

The findings of the audit (in draft) were made public by the Government early in 1994. Despite its limitations, the audit clearly supports the view that the activities of the Texpet consortium were responsible for serious environmental contamination over a large area of the Ecuadorian Amazon. The audit concluded: "*Oilfield development and production activities have caused contamination of soil and water at locations throughout the concession. Contamination of soil and water was observed at well sites, production stations and along roadways, flowlines and secondary pipelines*" (HBT Agra, 1993).

## The main legacies

* **Breach of the Law:** In 1991, Texaco (as well as Petroecuador) was fined for being in breach of Ecuadorian laws - specifically for not taking the necessary steps to avoid oil spillage from production pits from its Lago Agrio field in 1990 (see page 30).

* **Well Sites and Production Stations:** 65 per cent of the Texpet consortium production pits were badly constructed and constituted dangerous areas of contamination. 80 per cent of the pits were not maintained. The surrounding vicinity in a quarter of the oil wells were in a poor state. As much as 80 per cent of the

[1] Texaco refer to the consortium as 'Texpet' (a shortened term for the two companies - Texaco and Petroecuador - that comprised the consortium from 1977 to 1992). Originally, the consortium involved Texaco and Gulf but the latter relinquished their shareholding in two tranches to the national oil company, Corporacion Estatal Petrolera Ecuatoriana (CEPE) in 1974 and 1977 (CEPE was renamed Petroecuador in 1989). Texaco remained operator of the consortium until 1990 and relinquished their shareholding in 1992 (see Box 2). Wherever possible, the applicable company name - Texaco or Texpet - has been used. From 1964 to 1990, Texaco was operator for the consortium and therefore must bear overall responsibility for the companies' operations.

immediate surrounding area of wells and pits were polluted. The Texpet audit confirmed that during the period 1973 to 1990, spills were recorded at 93 well sites and 10 production stations. As many as 66 well sites (out of a total of 163) and 35 production station facilities (out of a total of 151) were assessed to have a high environmental impact rating for contamination (see pages 24 and 25). Evidence of subsurface contamination was also found.

* **Produced Water (effluent):** The quality of discharged produced water at times significantly exceeded the maximum quality criteria as recommended by the audit consultants, HBT Agra and a Petroecuador-Texaco Technical Committee (see pages 27 to 31). For example:

- The Ministry of Energy and Mines recorded 2,090 parts per million (ppm) hydrocarbon content in discharged produced water from the consortium's Guanta field (the recommended quality criteria for discharged produced water was set at 25 mg/l[2]). High levels were also recorded in two other Texpet fields. Texpet must take some, if not most, of the responsibility for the estimated 19 million gallons of oil which has been discharged into the Oriente in produced water.

- The Ministry also recorded 91,700 ppm chlorides in discharged produced water in the Texpet consortium's Atacapi field and high levels in two more Texpet fields. In 18 samples of produced water taken as part of the Texpet audit, 12 exceeded the recommended discharge quality criteria of 2,500 mg/l for chlorides (the data ranged from 4,540 mg/l in the Sacha field to 88,000 mg/l in the Atacapi field).

- Of the 18 produced water samples in the audit, they all exceeded the recommended discharge quality criteria of 40 mg/l for total suspended solids (ranging from 120 to 11,000 mg/l, the highest figure again originating from the Atacapi field). 12 samples exceeded the maximum criteria (5,000 mg/l) for total dissolved solids ranging from 5,790 to 147,000 mg/l, the highest figure again originating from the Atacapi field.

- Of the 18 audit samples, all but two exceeded the recommended discharge quality criteria of 1 mg/l for sulphides (ranging from 1.3 to 10.2 mg/l, the highest figure again originating from the Atacapi field).

* **Receiving Waters:** In turn, the produced water influenced the quality of the receiving waters (tributaries of the Amazon); "*the effluent discharges have influenced the water quality of five rivers...The effluents changed the water quality of some streams so that water quality for drinking and aquatic life was affected*" (HBT Agra, 1993). Again, as part of the audit, 21 samples were also collected from streams and rivers in the Texpet concession (see pages 31 to 35):

- The total suspended solids (TSS) in every sample exceeded the recommended receiving water quality criteria. The recommended level for TSS was to be 'absent' in drinking water but levels were recorded as high as 410 mg/l.

- Samples from the largest Texpet oil field (Shushufindi) recorded levels of total petroleum hydrocarbons and iron well in excess of the recommended criteria. The receiving waters - the Rios Niutshinac, Shushufindi and Eno - are important for aquatic life and used extensively for domestic purposes.

- Samples from the medium sized Auca field revealed elevated levels of sodium, chloride and total dissolved solids and "*are likely the result of effluent discharge from Auca South* [station]. *High concentrations of chloride and TDS* [total dissolved solids] *are characteristic of the effluent. Because the river is small and*

[2] In water, mg/l and parts per million (ppm) are equivalent units. Friends of the Earth has quoted the units as cited in the references (and, therefore, they are often used interchangeably in this report).

*has a low flow, its water quality can be significantly influenced by the effluent*" (HBT Agra, 1993). The river was only 1.5 metres wide and 0.5 metres deep at the point of discharge.

- A separate survey of receiving waters was also conducted in the concession by the Centre for Economic and Social Rights (CESR)[3]. Drinking water samples were found to have concentrations of polycyclic aromatic hydrocarbons (PAHs) ranging from 33 to 2,793 nanograms per litre (one thousand-millionth of a gram). In bathing water, the recorded nanograms per litre were between 10 and 1,488; and in samples of water leaking out of a waste pit, levels of between 46,500 and 405,634 nanograms per litre were found. In that 28 nanograms per litre constitutes a lifetime cancer risk, the US Environmental Protection Agency recommends levels in ambient water be reduced to zero. Aromatics are very volatile and are toxic to most types of living organisms (see pages 34 and 39).

* **Pipelines:** As builder, owner and operator of the trans-Ecuadorian pipeline (SOTE), Texaco must take responsibility for spills totalling nearly 17 million gallons (see pages 37 and 38).

* **Roads:** To service over 200 production wells and 15 producing oil fields, the contractors to Texaco (as operator) have built hundreds of kilometres of roads. 2,000 hectares of forest (equivalent to 3,300 football pitches) has been cleared in the Texpet concession due to the construction of primary roads and well site access roads. These roads have allowed colonists, land speculators, agro-industry and loggers to follow the company into the forest (see pages 36 and 37).

* **Forest Loss:** It is estimated that a total of 2,600 hectares of forest (equivalent to 4,300 football pitches) has been lost due directly to oil production and development facilities in the Texpet concession (see pages 25 and 36).

* **Compliance:** Friends of the Earth also believes that Texaco has failed to comply with:

- the company's own worldwide environmental practices (see pages 22 to 40);

- oil industry guidelines for operations in tropical forests (see pages 22 to 40);

- oil industry standards of good practice (see page 30);

- the 'spirit' of the company's contract with the Ecuadorian Government (see pages 42 to 44);

- the 'spirit' of Ecuadorian law relating to hydrocarbons and water, air and soil pollution (see pages 42 to 44). The Texpet audit confirms that "*activities likely to cause contamination were identified from pre-1990 operational practices. Therefore, the Consortium oil field operations prior to 1990 were potentially not in compliance with Ecuadorian Law and Regulations*" (HBT Agra, 1993).

* **The International Water Tribunal:** The jury of the International Water Tribunal, in a case brought against Texaco by the Ecuadorian law group CORDAVI (Corporacion de Investigaciones Jurdico-Ecologicas y de Defensa de la Vida), found sufficient evidence to conclude that:

---

[3] This sample survey, as well as the sample studies conducted as part of the Texpet audit, were undertaken in mid-1993. Texaco relinquished operational control of the consortium in 1990 and the company's contract expired in 1992. However, the CESR study concludes: "*Petroecuador continues to employ the environmentally dangerous equipment and practices inherited from Texaco, including the discharge of toxic wastes directly into the environment*" (see Brooke, 1994). The report continued that the blame still lay with Petroecuador **and** Texaco (Brooke, 1994).

- "*...large quantities of hydrocarbons, salts and hazardous substances...are found in waste waters discharged or spilled on soil and into surface waters*";

- "*These waste waters cause deterioration in the quality of the river water which is essential for the sustainable livelihood of the local population*";

- "*Insufficient and at most superficial measures were taken for retaining and minimizing spillages of oil and containing substances and leakages from pits*".

- "*it is the obligation of the defendants to take measures to prevent further or future damage, provide restitution and/or equitable compensation where restitution is not possible*".

Points 1 to 3 and 9 of the ruling, see appendix 2 (see also page 49).

## Environmental and Social Impacts of the Oil Industry

Large quantities of oil are known to have been spilt or discharged into the Ecuadorian Amazon; a significant (if unknown) proportion has originated from the Texpet concession. The physical effects of such massive oil contamination on ecosystems of the Amazon have been dramatic. Observers have reported a dramatic loss of biological diversity in rivers running through oil producing areas. Oil spills have a particularly strong effect on river edges, a zone of special importance for plants, fish and birds, and an area of settlement of riverine peoples.

No long-term, independent analytical assessment has been conducted to determine the impacts of the discharges in the Texpet concession. The effects of produced water (which are usually hot alkaline brines) on aquatic life are little understood but the high oxygen demand they create is likely to kill off aquatic communities and disrupt aquatic food chains. Heavy metals and hydrocarbons from produced water can bioaccumulate in the food chain, where they can effect water birds, humans and other animals. High levels of salts (chlorides) can kill soil and water micro-organisms that play a critical role in forest nutrient cycles, and disrupt the distribution and migration of fish.

The health effects of oil activities are difficult to verify because of poor health provision and monitoring. However, PAHs are known to be carcinogenic. The health of 1,465 Amazon residents was summarized in a study by a local health group, the Ecuadorian Union of Popular Health Promoters. Those exposed to hydrocarbons had a higher occurrence of fungal infections, dermatitis, nausea and abortions. Respiratory problems effecting oil workers from the flaring of gas have been reported from the Texpet concession.

The indigenous peoples of the North Eastern Oriente, the Cofan, Secoya and Siona have suffered particularly badly from petroleum development. The Cofan whose territory lies at the heart of the Texpet concession, now consist of less than 300 individuals and are considered gravely threatened as a people. The widespread contamination of drinking water in oil field areas means that the industry is having a profound effect on the people of the area. Another worrying effect of this contamination is the loss of fish in the diet, which normally forms the major proportion of protein intake amongst migrant and indigenous populations.

No long-term assessment has been made of the likely impact of forest clearance in one the most biologically diverse regions of the world. Clearance for the construction of roads has resulted in the loss of thousands of hectares of forest; an even greater impact is their role in stimulating colonization. Many indigenous populations have been affected by the routeing of roads through their land and through the impact of colonists.

## The Outcome of the Audit

The fact that Texpet agreed to conduct the audit reflects the wide ranging criticisms levelled at the consortium from environmentalists, local communities and indigenous peoples. It was also probably an attempt to diffuse growing political pressure and to allay fears surrounding the widely held view that Texpet had been complacent in its attitude towards local peoples and that the consortium's activities had been damaging to the environment. The audit's consultants calculated that the total cost of remediation for oil contamination in the Texpet concession was $13.3 million. However, Texaco "*maintain*[s] *that no (environmental) damage exists that is the company's responsibility*" (Reuters, 1994b). The company remains convinced that such operations were carried out within Ecuadorian regulations.

To date, the parent company Texaco Inc has agreed, in principle, to pay the Ecuadorian Government $3.8 million in favour of equipment repair and $5 million in tax. However, Friends of the Earth understands that Texaco has still not accepted any extended liability for its operations in Ecuador. In the meantime, the company launched a massive law suit of more than $500 million against the Ecuadorian Government for violating the oil exploration and development contract. The amount of $13.3 million is seen as completely inadequate by non-governmental organizations in Ecuador because if fails to reflect the ecological, social and cultural impacts caused by the company. However, Texaco's position in not accepting extended liability may be undermined by two factors. Firstly, the findings of the audit clearly reveals environmental degradation and contamination. Secondly, a law suit, filed against Texaco in the United States on behalf of Ecuadorian Amazon peoples, may eventually rule that the company is responsible for the costs of remedial action in the region.

Ecuadorian groups are recommending that the audit should not be rejected in its entirety but should be independently reopened and expanded to include a full historical, social and cultural perspective incorporating the highest environmental standards. Any such evaluation must be open to public scrutiny and meaningful public participation.

## Recommendations

* The Texpet audit should be reopened and expanded to include a comprehensive and impartial historical investigation of the social, cultural as well as the environmental impacts of Texaco's operations.

* Texaco must clean-up contaminated sites, repair outdated infrastructure and adequately compensate affected communities.

* Protected areas should be sacrosanct.

* The World Bank should oversee an environmental plan for the SOTE.

* A moratorium should be enforced on any future oil development in the Oriente.

* Any further development assistance should be withheld from Texaco or Petroecuador until adequate reparation of damages is made.

* A comprehensive debt reduction programme should be agreed between Ecuador and northern creditors.

Chapter 1

Introduction

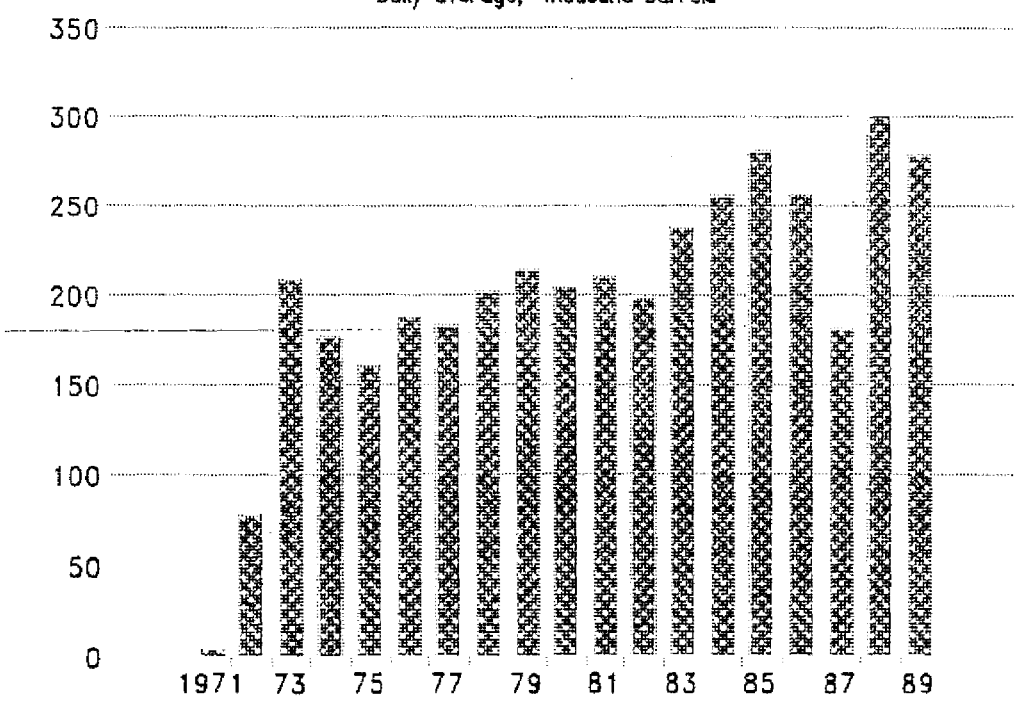
## Ecuador and Oil - the Historical Context

Ecuador has produced oil in commercial quantities since 1918. Until the Texaco-Gulf consortium's discovery in 1967 at Lago Agrio in the Amazon region of the country (the Oriente), production had been on a very small scale and confined to the coastal region (the Costa).

The search for petroleum had extended into the Oriente from as early as the 1940s. Shell Oil was granted concession rights covering the whole region but left in 1950 without discovering any commercial quantities of oil. Yet by the end of 1972, the situation for the region had changed dramatically: reserves of 3,200 million barrels had been discovered, a state oil company had been set up (CEPE - Corporacion Estatal Petrolera Ecuatoriana[1]), and the trans-Ecuadorian pipeline - the Sistema del Oleoducto Trans Ecuatoriano (SOTE) - had been constructed to transport the first oil out of the Oriente (Philip, 1979; Kimerling *et al*, 1991).

Oil has been known to native people of the Oriente since prehistoric times. Secat, a tar found in small quantities in cracks and fissures of exposed rock, was commonly used as pitch for boats (Martz, 1987). In complete contrast, the 1967 discovery heralded the start of the oil boom for Ecuador and the entry of the Oriente into the world economy. Large scale production of oil (see Figure 1) brought great changes

Fig 1: Ecuador's Crude Oil Production
Daily average, thousand barrels




Source: Kimerling *et al*, 1991.

[1] CEPE was subsequently reorganized in 1989 and renamed Petroecuador.

Table 3: Summary of Sites with a High Impact Subsurface Contamination Rating

| | Visual Evidence | Analytical Evidence |
|---|---|---|
| Agua Rico Field | | |
| Well 3 | Petroleum on groundwater | |
| Well 9 | Petroleum on groundwater | 67 ppm oil and grease in water |
| Auca Field | | |
| Central Station | No evidence | 13,800 ppm chloride in water |
| Sacha Field | | |
| North 1 Station | Oil in sand | 2,800 ppm oil and grease in soil at 3.5m. |
| Shushufindi Field | | |
| Central Station | Petroleum on groundwater | |
| North Station | Oil in sand | 1,100 ppm oil and grease in soil at 2m. |
| Well B57 | Oil in sand | 17,000 ppm oil and grease in soil at 2.7m. |

Source; HBT Agra, 1993.

drilling and testing activities (Kimerling *et al*, 1991). Additives in drilling muds can be very toxic and include biocides, bactericides, corrosion inhibitors, thickeners and chemicals to control ph. Many of these are only exempt from classification as hazardous waste in the US because of special measures taken to favour production during the oil crisis of the 1970s (OTA, 1992). They tend to be highly alkaline.

Information about the types of drilling muds used in Ecuador has never been made public but Texpet has never denied using oil-based muds. The environmental effects of drilling muds depends very much on the formulation employed - oil based muds are highly toxic and require special disposal. Water-based muds often contain high levels of heavy metals such as antimony, chromium and zinc. Polymer muds are available which avoid many of the problems of oil and water based muds.

**Production water wastes (sometimes also known as effluent[7]):** The Ecuadorian Ministry of Energy and Mines has calculated that, since the early 1970s, 19,000 million gallons[8] of liquid wastes (production water) have been discharged into the environment after brief periods in production pits (see Kimerling *et al*, 1991). Production water is a cocktail of liquids left over after the separation of oil and gas from the formation water and on discharge is composed mainly of water but also contains emulsified oil, salts and heavy metals including arsenic, cadmium, chromium, lead, mercury, vanadium and zinc. The effects of these hot alkaline brines on aquatic life are little understood but the high oxygen demand they create is likely to kill off aquatic communities and disrupt aquatic food chains. Heavy metals and hydrocarbons from produced water can bioaccumulate in the food chain, where they can affect humans, water birds and other animals (Green and Trett, 1989; Kimerling *et al*, 1991). The highest concentration of salts (chlorides) in the uncontaminated rivers and lakes of the Amazon reach seven parts per million (ppm), whereas the salt concentration in production discharges can reach as high as 100,000 ppm[9] (Reyes, 1990) (see Table 4). Such high levels of salts can kill soil and water micro-organisms

[7] Effluent is commonly used to describe both produced water and sewage. In oil fields, the former "*is generally of greatest environmental concern due to both its large volume and the large amount of contaminants it contains*" (HBT Agra, 1993).

[8] US gallons are used throughout this report: 1 US Gallon = 0.83 imperial gallons. 42 US gallons = 1 US barrel.

[9] Sea water has a salt concentration of 3,500 ppm; white water in the Amazon is between 0-2 ppm (Reyes, 1990).

that play a critical role in forest nutrient cycles, and disrupt the distribution and migration of fish (CORDAVI, 1991).

In a presentation to an international oil industry symposium in the US, a representative of Direccion Nacional de Medio Ambiente (DINAMA)[10], Ecuador's new environmental watchdog within the Ministry of Energy and Mines, admitted that: "*The discharge of this* [produced] *water in small rivers or estuaries can create a chlorinity gradient that operates as an invisible barrier preventing the normal migration of fish and other aquatic life between upstream and downstream waters. The result is biological isolation, which could affect reproductive patterns and species distribution. Because of the content of sulphates, bicarbonates, heavy metals and hydrocarbons ...no river life can survive in the influence area of the discharges*" (Reyes, 1990). Amongst DINAMA's findings (see Table 4) were data from two fields within the concession area of the Texpet consortium - 91,700 ppm chlorides from Atacapi field discharges and 2,090 ppm hydrocarbons from discharges at the Guanta field[11] (Reyes, 1990). These levels substantially exceed the Texpet audit's maximum produced water quality criteria for chlorides and hydrocarbons as recommended by the consultants, HBT Agra (working in conjunction with a Petroecuador-Texaco Technical Committee). The criteria for these two parameters were set at a maximum 2,500 mg/l for chlorides and 25 mg/l for total hydrocarbon petroleum[12]. The consultants also concluded for all the criteria: "[the] *high levels within the reviewed set of assessment criteria were considered adequate because of the substantial volume of water flowing in the Amazon drainage basin*" (HBT Agra, 1992). Friends of the Earth has been critical of the audit's technical criteria (see appendix 1).

Table 4. Quality parameters of produced water discharges from four Texpet consortium fields*

| Field | ph | | Chlorides (ppm or mg/l) | | Hydrocarbon (ppm or mg/l) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | (1) | (2) |
| Atacapi | | | | | | |
| Pit-river | 6.0 | 5.5-9.5 | 91,700 | 2,500 | 10.0 | 25.0 |
| Wash tank-pit | 6.2 | 5.5-9.5 | 87,900 | 2,500 | 141.0 | 25.0 |
| Parahuacu | | | | | | |
| Wash tank-pit | 7.3 | 5.5-9.5 | 19,500 | 2,500 | 54.0 | 25.0 |
| river discharge | 6.4 | 5.5-9.5 | 6,000 | 2,500 | 141.0 | 25.0 |
| Lago Agrio | | | | | | |
| North station | 6.74 | 5.5-9.5 | 6,100 | 2,500 | 105.0 | 25.0 |
| South station | 6.37 | 5.5-9.5 | 6,600 | 2,500 | 231.0 | 25.0 |
| Guanta | 7.89 | 5.5-9.5 | - | - | 2,090.0 | 25.0 |

* The selected parameters (ph, chlorides and hydrocarbons) in this table were the only criteria included in both sources (Reyes, 1990; HBT Agra, 1992).
(1) produced water discharged
(2) Maximum criteria for effluent quality Petroecuador-Texaco Oriente Oilfields as proposed by consultants HBT Agra Ltd in conjunction with a High Level Technical Committee Petroecuador-Texaco consortium.

Sources: Reyes, 1990; HBT Agra 1992.

[10] In 1990, apparently in an attempt to upgrade its efforts towards the environment, the Ministry of Energy and Mines established a new environmental department, the Subsecretario de Medio Ambiente (SMA); under its auspices, DIGEMA was renamed DINAMA (Kimerling *et al*, 1991).

[11] Hydrocarbons can affect aquatic life at between 1-100 parts per billion (Kimerling *et al*, 1991).

[12] In water, mg/l and parts per million (ppm) are equivalent units and are used interchangeably in this report (see footnote 2, page 6).

## Table 5. Produced water quality data for Texpet Oriente Oil Fields, June 1993

| | Water Quality Criteria | Shushufindi | | | Agua Rico | Sacha | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| pH-field (units) | 5.5-9.5 | 7.16 | 7.36 | 7.28 | 6.89 | 7.6 | 7.4 | 7.5 | 6.8 | 7.1 |
| pH (units) | 5.5-9.5 | 6.53 | 6.3 | 6.1 | 6.70 | 6.55 | 6.35 | 6.45 | 6.23 | **3.22** |
| Chloride, dissolved | 2,500 | **20,000** | **11,200** | **28,200** | **32,600** | 1,580 | 2,400 | **4,540** | 113 | 1,630 |
| Total suspended solids | 40 | **2,150** | **540** | **1,100** | **365** | **442** | **120** | **320** | **164** | **324** |
| Total dissolved solids | 5,000 | **39,100** | **20,200** | **49,700** | **55,400** | 3,130 | 4,540 | **8,180** | 356 | 3,240 |
| Total petroleum hydrocarbons (C5-30) | 25 | 3.6 | 5.4 | 4.1 | 7.5 | 1.0 | 4.7 | 1.9 | <0.2 | 8.7 |
| Sulphide | 1.0 | **8.1** | **3.2** | **2.9** | **3.6** | **1.5** | **2.6** | 0.7 | 0.3 | **2.0** |
| Phosphorous | 2 | 0.16 | 0.35 | 0.19 | 0.1 | 0.02 | 0.21 | 0.25 | 0.11 | 0.80 |

Table 5 continued:

| | Water Quality Criteria | Yuca | Cononaco | Auca | | Lago Agrio | | Atacapi | Parahuaca | Guanta |
|---|---|---|---|---|---|---|---|---|---|---|
| | | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
| pH-field (units) | 5.5-9.5 | 6.7 | 8.1 | 7.3 | 7.4 | 7.1 | 7.3 | **0.74** | 6.4 | 6.3 |
| pH (units) | 5.5-9.5 | 6.61 | 7.2 | 6.52 | 7.13 | 7.07 | 6.5 | 5.5 | **4.8** | **4.44** |
| Chloride, dissolved | 2,500 | **30,400** | 670 | **3,270** | **13,700** | 418 | **5,130** | **88,000** | 6,020 | **48,900** |
| Total suspended solids | 40 | **808** | **124** | **310** | **756** | **168** | **1,270** | **11,000** | **818** | **4,470** |
| Total dissolved solids | 5,000 | **52,700** | 1,510 | **5,790** | **24,100** | 1,020 | **10,200** | **147,000** | **10,300** | **82,400** |
| Total petroleum hydrocarbons (C5-30) | 25 | 2.2 | 3.6 | 5.9 | 2.6 | 0.5 | 21 | 1.0 | 4.1 | 3.0 |
| Sulphide | 1.0 | **7.8** | **1.4** | **4.5** | **5.3** | **1.3** | **1.7** | **10.2** | **5.9** | **7.0** |
| Phosphorous | 2 | 0.59 | 0.53 | 0.12 | 0.50 | 0.50 | 0.84 | 0.74 | 0.15 | 0.16 |

Notes: All values reported in mg/l. Values in bold fall outside the recommended quality criteria.

Source: HBT Agra, 1993.

The audit also examined the quality of 18 produced water samples from 10 fields in the concession (see Table 5; see also page 22). Dissolved chlorides exceeded the recommended produced water quality criteria of 2,500 mg/l on 12 occasions with the sample at the Atacapi field being the worst offender (reinforcing the results from the Ministry of Energy and Mines in 1990, see above). Total suspended solids exceeded the recommended criteria in every sample. 12 samples exceeded the limits set for total dissolved solids. Sulphide discharges also proved to be high in all but two of the samples. In almost every single case, the worst offender were discharges from the Atacapi field. Of the parameters, only total petroleum hydrocarbons and phosphorous always fell within the recommended limits in each of the 18 samples.

Friends of the Earth believes that Texaco has used a spurious argument to affirm the safety of production water discharges. The company claims that toxicity tests carried out on the effects of undiluted production water on water fleas and fish in the US did not cause mortality. This, in part, led to the conclusion: "*This affirms that the use of pit technology for water treatment is environmentally effective and safe*" (Texaco, 1992c). The fact that these test organisms do not die in the production water created by a well in Wyoming tells us virtually nothing about the ecological effects of wastes within more complex Amazonian ecosystems. Indeed, Texaco seems to agree; in criticizing work of CORDAVI for using 'inappropriate' saltwater studies as relevant to freshwater conditions as part of their submission against Texaco to the International Water Tribunal, the company states: "*The water chemistry and varying tolerances of the creatures to changes in their environment makes it impossible to be able to correctly conclude anything about one environment from the other*" (Texaco, 1992b). Moreover, that Texpet did not carry out similar long-term studies during approximately 20 years of oil production in Ecuador is an indication of the standards it applied to their work in the country (see HBT Agra, 1992; also section immediately below)[13]. Receiving rivers and water bodies were not tested biologically or chemically for the additives used in the production process. The company claims that such an analysis for produced water would be "*expensive as well as fruitless. Any trace of one of these chemicals that could be in the water would be in a concentration too low to measure*" (Texaco, 1992b). Yet by not doing so, the company failed to comply with its own guidelines for environmental practices; "*The quality of water to be discharged **must** be determined*" (Texaco, 1991a) (emphasis added).

The worldwide *Oil Industry Operating Guideline for Tropical Rainforests* states clearly that production water should preferably be reinjected either into the producing formation[14] or another non-potable water formation (E & P Forum, 1991). However, Texaco's own guidelines declare that the discharge of produced water to local water bodies should be considered as the first option. Moreover, the company claims that the same practices are followed at their wells in Wyoming and imply that it is common practice (Texaco, 1992c). Far from being the rule, it is the exception in the US for waste water to be discharged locally. Despite additional expense, 97 per cent of production water in the US is reinjected into the wells to avoid the problems associated with surface discharge (OTA, 1992). Therefore, Texaco did not follow oil industry 'standards' of good practice in its operations in Ecuador when compared for example to the US (see Texaco, 1992b; 1992c).

In response to the ruling of the International Water Tribunal, Texaco claimed that "*during Texpet's term as operator, there was no direct discharge of oil into rivers or streams*" (Texaco, 1992b). However, in 1991, Texaco was fined $8,000 by the

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[13] In establishing the assessment criteria for produced water discharges, HBT Agra Ltd confirmed: "*One weakness of the environmental impact* [assessment criteria] *approach is the need to monitor the hydrology and water quality of receiving rivers over a sufficiently long time period. Without long-term monitoring data, it is impossible to establish realistic and meaningful quality standards*" (HBT Agra, 1992).

[14] See footnote 4, page 20 for an explanation of this technique.

Subsecretaria de Medio Ambiente (SMA) for not taking the necessary steps to avoid oil spillage from production pits from its North Lago Agrio field in April 1990 (*El Comercio*, 1991). Moreover staff at DINAMA calculated that over 19 million gallons of oil have been discharged in waste water since 1972 (Kimerling *et al*, 1991)[15]. This suggests that more oil has been lost during the production stage than in the 30 recorded spills from the SOTE pipeline (see later section), and that production pits were the single biggest source of oil contamination in the Ecuadorian Amazon. It is impossible to ascertain with any degree of certainty how much of the 19 million gallons can be attributed to the Texpet consortium facilities although with 80 per cent of the country's oil production, the proportion will be significant. DINAMA found 2,000 ppm hydrocarbon content - twice the anticipated average for the Oriente (see footnote 15) - in discharges from the Guanta field (Reyes, 1990).

**Quality of Receiving Waters:** The validity of studies testing pollution in Amazonian freshwater from produced water is more questionable: the findings will be particularly dependent on where the test was conducted in relation to the discharge, the time lapse, the frequency of tests and the amount and velocity of flowing water. No long-term studies of the quality of receiving waters have been conducted by the Texpet consortium (see footnote 13). However the work carried out by CORDAVI as part of their submission to the International Water Tribunal is relevant here (CORDAVI, 1991). In 1981, a study of water pollution was conducted in a number of locations in and around oil fields of the Oriente; included were two water sample sites from streams (Numbers 12 and 13 and categorized as 'Water in Oil Areas') inside the Texpet consortium Sacha field (see Figure 2, Table 2 and appendix 4)[16]. Amongst their findings were (CORDAVI, 1991):

> Site 13: a 32.1 per cent oxygen deficit described by CORDAVI (1991) as "*alarming*" (site 12 recorded a figure of 23.6 per cent). CORDAVI (1991) continues: "*Without oxygen no biological life in natural waters can develop...An oxygen deficit higher than 20 per cent provokes a reduction of the amount of fish, higher than 40 per cent causes death of most of the fish*".
>
> Site 12: "*relatively high*" concentrations of carbon dioxide (12.2 per cent)
>
> Site 12 and 13: "*These* [sample] *rivers also show a great content of salts, which is indicated by the values of salinity, conductivity and hardness, for example: on sites...# 12 and 13 (Sacha Field)*". The levels of hardness $CaCO_3$ (ppm) in sites 12 and 13 respectively were 56.9/64.1 and these levels were only exceeded in two of the other 10 sample sites.

The Texpet audit also tested (in June 1993) the quality of receiving rivers and streams from the consortium's concession (21 upstream and downstream samples were taken from 7 fields) (Table 6). However, not all the samples, it would appear, were confined to streams: "*The Effluent from the Aguarico field was discharged into the forest with no direct connection to a receiving stream.* ***The effluent has had a notable effect on the forest. The vegetation adjacent to the discharge was dead or yellowed*** (HBT Agra, 1993; our emphasis). In addition, in the case of the Yuca field, the "*effluent flows along a small and poorly defined stream, through plantations, and may eventually discharge into Laguna Taracoa, a distance of about three kilometres.* ***Because the stream contains mainly produced water,*** *the sampling was limited to the effluent discharge site*" (HBT Agra, 1993; our emphasis).

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[15] To reach this figure, DINAMA estimated that the average hydrocarbon content of produced water discharges in the Oriente was 1,000 ppm.

[16] The study was directed by chemical engineer Richard Lehner, the German Professor of the Chemical Sciences Institute of the ESPOL at Guayaquil. The results and analysis was conducted in the laboratories of ESPOL and the Faculty of Chemical Sciences of the University of Guayaquil (CORDAVI, 1991).

Table 6. Water quality data for Streams and Rivers in Texpet Oriente Oil Fields, June 1993

| | Water Quality Criteria | | Shushufindi | | | | | | | Agua Rico | Sacha | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Drinking | Aquatic Life | (19) | [20] | [21] | (22) | [23] | [24] | (25) | [26] | [27] | [28] |
| pH-field (units) | 6.0-9.0 | 4.0-9.0 | 6.55 | 6.04 | 7.30 | **5.86** | **5.93** | 6.22 | 6.53 | 7.04 | 7.31 | 7.19 |
| pH (units) | 6.0-9.0 | 4.0-9.0 | 7.61 | 7.01 | 7.10 | 7.16 | 7.07 | 7.16 | 7.27 | 7.63 | 7.18 | 7.22 |
| Dissolved Oxygen | | >5.0 | Ranged from 4.0 to 6.0 mg/l in June 1993 | | | | | | | | | |
| Turbidity | 100 | | 11 | 6.4 | 16 | 2.1 | 8 | 39 | 21 | 100 | 19 | 9.3 |
| Colour | 20 | | 16 | 5 | 12 | 20 | 17 | **21** | 19 | 7 | 13 | 19 |
| Calcium, dissolved | 75 | 75 | 8 | 17 | 20 | 5.2 | 4.8 | 5.2 | 5.4 | 13 | 5.0 | 8.3 |
| Magnesium, dissolved | 50 | 50 | 3.9 | 6.2 | 7.3 | 2.5 | 2.3 | 2.5 | 2.7 | 1.2 | 2.5 | 2.9 |
| Iron | 0.3 | 0.3 | **1** | **1.3** | **1.4** | **1** | **1.2** | **1.4** | **1.4** | **1.2** | 0.1 | 0.1 |
| Manganese, dissolved | 0.5 | 0.1 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Bicarbonate, dissolved | 100 | | 57 | 63 | 62 | 43 | 37 | 39 | 45 | 48 | 37 | 50 |
| Carbonate, dissolved | 50 | | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Chloride, dissolved | 250 | 1,000 | 0.8 | 150 | 155 | 0.7 | 0.9 | 0.6 | 0.8 | 2.5 | 1.1 | 9.0 |
| Sulphate, dissolved | 500 | 500 | 1.5 | 0.9 | 3.7 | 0.6 | 0.6 | 1.6 | 1.1 | 5.1 | 0.7 | 0.6 |
| Alkalinity (CaCO3) | 250 | | 47 | 52 | 50 | 35 | 30 | 32 | 37 | **40** | 30 | 41 |
| Hardness (CaCO3) | 250 | | 36 | 68 | 80 | 23 | 21 | 23 | 25 | 37 | 23 | 33 |
| Total suspended solids | Absent | | **27** | **65** | **210** | **105** | **16** | **60** | **410** | **260** | **168** | **276** |
| Total dissolved solids | 1,000 | | 92 | 365 | 368 | 77 | 80 | 83 | 73 | 77 | 84 | 93 |
| Total petroleum hydrocarbons (C5-30) | 1.0 | 1.0 | 0.9 | **2.4** | **1.7** | **2.7** | **3.9** | **3.1** | **3.3** | **2.5** | 0.3 | 0.4 |

Continued