Glycol waste incineration in a wet process

Parvaiz Naim

ABSTRACT

Air samples collected from the surroundings of a wet-process cement kiln showed no difference in air quality before and after glycol waste incineration. Use of EIA techniques, on the other hand, was more useful in ascertaining the actual problems associated with the incineration process. The life cycle analysis and computer model revealed that the waste largely came out of the kiln unburned. This had the potential of damaging both the electrostatic precipitator and human health. An analysis of alternatives identified that direct waste feeding into the burning zone ensured complete pyrolysis of waste including dioxins and furans, without damaging equipment or human health. A scientific and technical knowledge of the system was found essential for making effective use of EIA techniques in planning and decision making.

Introduction

A polyester staple fibre manufacturing unit in Pakistan used to dump its glycol waste in the sea. Because of public and government pressure, the waste was sent to a wet-process cement factory. There it was mixed with the raw material slurry and fed into the cement kiln. A team of scientists did not find any difference in the quality of cement and all samples before and after glycol waste incineration. The EPA nonetheless insisted that the incineration activity should be examined using EIA techniques. The polyester manufacturers thus approached IUCN-Pakistan office, which conducted the study in April-May 1997.

The cement factory on three sides had 2000 ft high semi-arid hills with several mining and quarry operations for extracting salt, coal, limestone, gypsum, clay and gravel. The fourth side had open land interspersed with a few small villages and some agricultural fields. Wildlife largely comprised jackals, rabbits, monitor lizards, snakes, rodents and a variety of birds. Winters were mild (rarely falling below 0^{o}C) and summers were hot (frequently above 40^{o}C). Much of rain came during the monsoon period (June-August).

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The cement factory had 3 kilns, each with 600 ton production capacity. Each kiln burned 100 tones high-sulphur (2.2-3.5%S) furnace oil. Smoke stacks were 52 metres high. During the trials, one ton of glycol waste was mixed with 1000 tonnes of raw material slurry and fed into the kiln from its cold end where temperatures were 180°C. The 135 metre kiln had a burning zone on the other end with temperatures around 1500°C.

NATURE AND SCOPE OF ISSUES

- Workers complained about an unpleasant smell when glycol waste was mixed with raw material slurry; it caused headaches, running noses and vomiting in some workers.
- The management complained about choking of slurry feed pipes by glycol waste, which sometimes caused system shut-down.
- The general public complained about dust and smoke from the cement factory. They did not appear concerned about glycol waste incineration.
- The EPA expressed concern about incineration efficiency and the production of dioxins.

PROCESS AND PROCEDURAL CONTEXT

Since the snapshot air quality sampling had not provided satisfactory answers, it was decided to use a computer model for predicting pollutant fall-out around the factory throughout a year. Because of the EPA's concern about incineration, it was decided to conduct a life cycle analysis of the process.

APPROACH TAKEN

The entire process was studied step-by-step. This included detailed examination of waste transport, storage and handling, feeding temperatures, cement kiln internal working; temperature regime in the kiln; exhaust system etc. An air dispersion model (RTDM) was used to determine exhaust dispersion patterns. This information was projected on a satellite imagery of the area. An analysis of alternatives was done, focusing on a comparison of two incineration options (i.e. waste mixing with slurry and kiln feeding from cold end; and direct waste injection into the burning zone).

RESULT AND IMPLICATIONS

The life cycle analysis showed that the approach tried for waste incineration did not subject the waste to a high temperature. Fed from the cold end, much of the glycol waste evaporated during the slurry drying process.

The remaining waste caught fire at 200°C and escaped to the smoke stack. It never reached the burning zone on the other side of the cement kiln where the temperature was 1500°C. The escape of unburned and partly burned glycol waste threatened the functioning of the electrostatic precipitator by coating its charged surfaces. The small quantity of escaping fumes was difficult to detect in the factory surroundings but had the potential of affecting human health. Small amounts of polymers are known to deceive human immune systems, mimic certain hormones and act as endocrine disrupters altering metabolic and growth pattern especially in the foetus.

The option of direct waste feed in the burning zone offered organic component pyrolysis immediately after entry into the burning zone. The gaseous component attained a temperature of 1500°C and stayed in the kiln for about 10 seconds. This condition was more than sufficient for dioxins and furans destruction. The organic matter free exhaust did not affect the electrostatic precipitator or surroundings. The inorganic residue got mixed with cement without affecting its quality.

LESSONS LEARNED

- The life cycle analysis and computer model use were helpful in the identification of environmental problems which could not be ascertained using an actual snapshot field air quality survey.
- Snapshot studies can miss the big picture.
- Scientific and technical knowledge of a given system is essential for making effective use of EIA techniques in planning and decision.

The author:

Parvaiz Naim
IUCN Pakistan
Director EAS
1 Bath Island Road
Karachi 75530
PAKISTAN

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