

Chimia 54 (2000) 514–516
© Neue Schweizerische Chemische Gesellschaft
ISSN 0009–4293

Motivation of Employees – A Cornerstone for Higher Eco-efficiency in Wastewater Treatment

Hans Amrhein, Manuel Glauser, and Michael Matthes*

Abstract: Various production processes at Roche AG, Sisseln generate large quantities of wastewater, which is treated in the company's own wastewater treatment plant. Although all statutory requirements are being met, the plant has set itself an ambitious target to increase eco-efficiency as part of the Responsible Care Program. After two years, the first net benefits are becoming clear. Over this period, it has been possible to achieve a 27% reduction in the solvent load of wastewater, which has had not only environmental benefits but also measurable economic benefits. This has been achieved by various measures in the production plants, supported by an interdepartmental working team and direct employee participation in the resultant cost savings.

Keywords: Eco-efficiency · Green chemistry · Motivation · Responsible Care · Wastewater treatment

1. Introduction

For many years the chemical industry has been keenly aware that practical implementation of environmental protection is a vital and essential factor in promoting sustainability. As a result, it has, in the past, been possible to achieve significant successes at low cost. However, further improvements may be achieved by using innovative management systems [1] and developing a global strategy [2]. In Switzerland, the idea of a global strategy is fostered by the 'Responsible Care' initiative [3]. As long ago as 1991, under the slogan 'progress with responsibility', the chemical industry undertook to comply with seven principles which define safety and protection of humans and the environment as the overriding priority.

These measures must be owned and actively supported by senior management. Only in this way can the messages be plausibly communicated to all employees, which is essential to the success of the program.

Using the environmental target 'reducing wastewater load' by way of example, the following will outline how such improvement programs can be successfully implemented in practice.

*Correspondence: Dr. M. Matthes
Roche Ltd, Sisseln
Safety & Environmental Protection
Bldg 324/114
CH-4334 Sisseln
Tel.: +41 62 866 24 52
Fax: +41 62 866 20 75
E-Mail: michael.matthes@roche.com

2. Environmental Protection as a Plant Objective

Roche AG Sisseln is a major production site for the F. Hoffmann-La Roche Group. A range of vitamins and pharmaceutical active substances are chemically synthesized and some are also converted into their formulations. Given the large quantities produced by the site, large amounts of energy and raw materials are required for these transformations. Environmental protection has accordingly been of great significance to the entire site for many years. Applying the 'polluter pays' principle to the internal allocation of costs also makes a major contribution. It is worthwhile for each plant to produce in the most environmentally sensitive manner that is possible, so keeping its disposal costs low.

Over the last three years, such efforts have been intensified by setting clearly measurable targets. One of the five plant objectives for the period 1999–2003 was worded as follows:

'We work safely and reduce waste, wastewater and energy consumption.'

Each year, the site management uses this principle to set clear objectives which are communicated to all departments. It is very important for the site to concentrate on the major problem areas while still addressing as many employees as possible.

This process is also supported by the Divisional Eco-delegate, whose task it is to initiate environmental activities

throughout the Vitamins and Fine Chemicals Division. This also emphasizes the Executive Committee's clear belief in environmental protection, which further motivates the site.

The specific environmental target 'reducing solvent load in chemical wastewater' was set for the years 1998 and 1999. This target was set because the presence of solvents in wastewater not only means losing expensive raw materials but also entails considerable treatment costs in the wastewater treatment plant.

3. Implementation of the Targets in a Matrix Team

In order to ensure rapid implementation of the target mentioned above, a matrix team consisting of representatives from the production plants and the Environmental Protection department was set up. This ensures that the polluter is directly involved and the ideas generated are quickly and efficiently implemented. Furthermore, the partnership between all the parties involved plays a significant role for a successful teamwork. Supervision by the Environmental Protection department is kept to a minimum while simultaneously the direct responsibility of the plants increases. This further improves eco-efficiency.

Qualifications for members of this working team were technical expertise and a high level of self motivation. Putting the Environmental Protection de-

partment in charge of the team has proved to be a positive development. The team leader must act as a motivator and as a catalyst for new ideas.

Regular meetings were held to analyze problems, collect ideas and initiate measures. Proposed solutions were evaluated on the basis of an analysis of the inputs and outputs of a process. The differing viewpoints of team members had an additional positive influence on the outcome. The findings for one plant were able to benefit another plant by facilitating implementation of similar measures in the second.

Team members act as multipliers in their departments by familiarizing colleagues in the plants with the issues. As awareness increases, ideas and proposals flow back to the team.

It took around three months until the first results were seen. This start-up time lag is understandable when the time taken to identify and work on the problem in the team, to take a decision and to implement it in the plant is taken into account. Current production runs must also often be taken into account.

The first year saw the implementation of simple projects involving little cost. In the second phase, more complex measures were addressed. More costly technical activities are coordinated with the budget and, if likely to succeed, are implemented as part of maintenance and new construction programs.

While working in an interdepartmental matrix team undoubtedly has its advantages, there is often a conflict of objectives for team members as priorities have to be repeatedly redefined due to multiple demands. In such situations the team leader's commitment is particularly needed. Occasional participation of the site manager in team meetings also has a positive effect on motivation.

4. Presentation and Communication of Results

Wastewater from production processes (chemical wastewater) is treated in the in-house wastewater treatment plant (WWTP). The individual treatment stages, such as physico-chemical preclarification, aeration and settle basins, are under cover. Exhaust air from the entire plant is purified with activated carbon.

On arrival at the wastewater treatment plant, the organic solvents in the chemical wastewater are mechanically separated in a separator and incinerated on site. Solvent residues adsorbed on the acti-

vated carbon are desorbed with steam, separated from the aqueous phase and also incinerated on site.

Any reduction in the quantity of solvents in the chemical wastewater not only reduces residual emissions after purification of the exhaust air from the WWTP, but also cuts the NO_x and CO₂ emissions from incineration of these substances. Moreover, disposal costs can be reduced and the service life of the activated carbon in the exhaust air treatment plant extended.

The environmental targets for the site are shown in the Table while the results achieved are shown in Fig. 1.

1998 saw an 11.0% reduction in the relative solvent load in chemical wastewater (relative to 1 metric ton of product and on the basis of the preceding year). This generated cost savings of CHF 87 000. 1999 saw a further 18.1% reduction in the relative solvent load, giving cost savings of CHF 110 000. While production output rose by 6.8% over the 1997–1999 period, the absolute quantity of solvents in the chemical wastewater fell by 22.1% over the same period.

What measures gave rise to these impressive results? The following are just examples from a range of many individual measures:

- Production plant cleaning procedures were optimized, so reducing the sol-

vent load of wastewater. Introduction of an additional cleaning step (pre-rinsing) means that a large proportion of the solvent which is still present is sent to a wastewater stripper or sent directly to incineration.

- Wastewater pretreatment by stripping is a common method for reducing levels of highly volatile compounds. Plant efficiency was considerably boosted by overhauling the measurement and control systems and optimizing control parameters (see Fig. 2).
- Many improvements may be achieved by taking an overall view when designing replacement plants. For example, optimized design of a new rectifying column achieved solvent savings of 50 metric tons per year, so correspondingly reducing the load on the WWTP.

Clearly, a one-off communication of the results when distributing the prizes was not enough to achieve these results. Firstly, the results are continuously fed back to the employees in the relevant departments by the matrix team members. Moreover, quarterly reports in the in-house newsletter keep management and all staff updated with developments. Keeping management and staff regularly informed has showed a positive impact on overall results. Sisseln's successes were also published in Roche Basel's

Table. Environmental targets, Roche AG, Sisseln

Year	Campaign	Target: Reduction of solvent levels in chemical wastewater ^{a)}
1998	'1998 environment campaign'	-10%
1999	'1999 environment program'	-9%
2000	'2000 environment initiative'	-6%

^{a)} relative to 1 metric ton of product and on the basis of the preceding year.

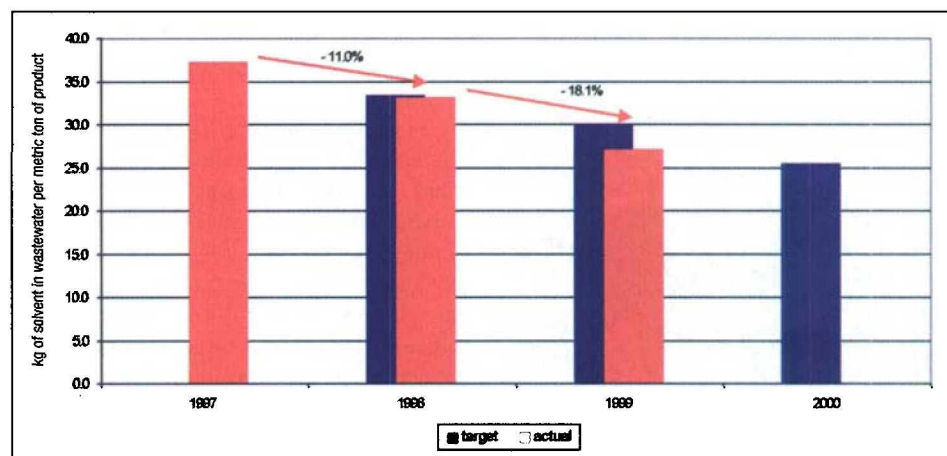


Fig. 1. Monitoring the success of the environment campaign

head office newsletter and in the Group's international newsletter 'Hexagon'. This naturally boosted the pride felt by personnel at Sisseln in their achievements and also increased their motivation. But it also allows other companies to 'plan' similar successes.

5. Motivation as the Driving Force for Performance

Plant management and the Divisional Eco-delegate soon recognized that site targets which concern the majority of personnel can only be achieved if there is a high level of motivation for change and improvement. This very high level of motivation in all the staff involved has been achieved by three factors: visible support from the most senior levels of management, communication and an adequate bonus system.

At an information event at the beginning of 1998, the Roche management called for a reduction in the solvent loading of wastewater. The one-week exhibition, located in the staff canteen, ran under the slogan 'Boosting cost savings with environmental protection'. The event provided all staff with the opportunity to take a closer look under a microscope at the mysterious world of bacteria in the WWTP or to familiarize themselves with the individual stages of wastewater treatment. Using a mixture of interactive experience, poster displays and discussions with top management, the environmental and economic poten-

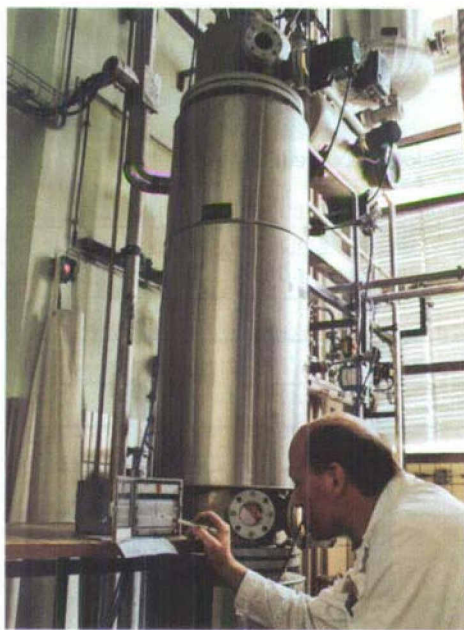


Fig. 2. Optimization of wastewater strippers in the production plants made a substantial contribution to success.

tial of this site target was explained to all staff. All employees were invited to sign up to the '1998 environmental campaign', so indicating their active support in achieving the target. Reaching the goal would mean that every participant in this 'environmental competition' would receive a CHF 50 Swiss Federal Railways voucher. Some 80% of staff had stated that they were willing to provide their active support to the '1998 environmental campaign'.

Early in 1999 the Swiss Federal Railways vouchers were distributed in the presence of site management during a four-day poster exhibition, again in the staff canteen (see Fig. 3). The posters showed how the target had been achieved in terms of quantity of solvent per metric ton of product and in terms of the savings in operating costs.

Since 1998's target was reached so decisively, the same approach of 'Commitment by Management, Communication and Reward' was used the following year too.

The momentum and motivation of the staff for further improvements was harnessed again for the '1999 environmental program'. Prior analysis by specialists revealed that there was still scope for generating further savings by reducing solvent levels in the wastewater. Again, everyone was given the opportunity to sign up to the program and again to receive a bonus if the target was achieved.

In fact, the target for the '1999 environmental program' was also significantly exceeded. In May 2000, each of the some 800 participants received an attractive sports bag bearing the Roche environment logo. For the last time, the targets specified for 2000 in the '2000 environmental initiative' relate to reducing solvent levels, as still further improvements are anticipated from process-integrated measures.

6. Future of the Bonus Approach

The experience of Roche AG Sisseln has shown that motivation and commitment to work increase if the staff involved share in the success by way of a bonus. The question does, however, arise as to whether targets relating to all staff can always be found and whether such indiscriminate hand-outs of bonuses are the right way forward in the long term. In any event, the decision has been made at the Sisseln site to abandon the idea of giving each individual member of staff a bonus when the target is achieved. In-

stead, the interdepartmental teams in the plant will in future be able to reward directly those individuals, plant teams or entire departments which have made an above-average contribution to any improvement. The intention is increasingly to reward those who have made a substantial contribution to achieving a target.

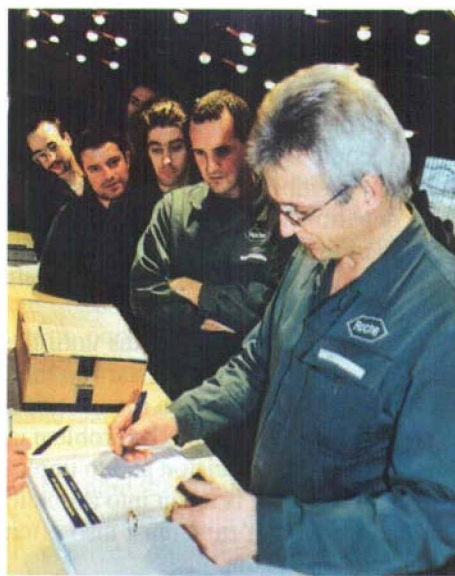


Fig. 3. Well-deserved reward to staff for their efforts.

7. Outlook

On the basis of prior experience, it is to be expected that after three years there will be little further scope for improvement in solvent levels in chemical wastewater. Accordingly, from the beginning of next year, the emphasis will probably be on other targets. Fortunately, other teams are working on other important topics such as energy saving or reducing quantities of waste. These groups are expected to propose targets, which will be examined and set by management. This flexible approach allows a rapid reaction to be made to current issues and thus guarantees still more effective environmental protection. Eco-efficiency has thus developed into an essential prerequisite for all activities in the site.

Received: June 13, 2000

- [1] W. Jucker, 'Reduction of Chemical Waste Means Sustainable Development', *Chimia* 2000, 54, 500.
- [2] Rio Declaration, Agenda 21, blueprint for sustainable development, Rio Earth Summit, 1992.
- [3] SSCI, Swiss Society for Chemical Industries, 'Responsible Care, Progress with responsibility', 1991.