3rd Int. Disposal Conf.,
Karlskoga, Sweden, 2003.

RISK ANALYSIS AND RISK ASSESSMENT IN THE PRODUCTION OF ENERGY FROM WASTE AND BIOMASS FUEL

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BACKGROUND

During the 1995-96 fiscal year, the National Board of Occupational Safety and Health and five Inspection Districts have conducted a project entitled *Work environment aspects of the ecocyclic management of residual products and waste.*

The purpose of this project has been to develop within the National Occupational Safety and Health Administration a consensus view of matters relating to work environment aspects of the ecocyclic society. The aim has been to promote a course of development in which work environment objectives are harmonised with external environmental targets. This means preventing work environment problems resulting from the ecocyclic adaptation of residual products, by translating our knowledge into action, so that it will exert a beneficial influence *conducive to the prevention of work injuries and accidents.*

Refuse collection and disposal employees have by tradition been prone to many kinds of work injuries. Their injury risk is about three times that of working life in general. Refuse collection workers are above all prone to ergonomic injuries and accidents during the collection of refuge. Now that container collection is being introduced and work is in progress to reduce the element of stress in this branch of employment, we can hope for a reduction of work injuries. At the same time, unfortunately, one finds that containers are tending to grow larger and more unwieldy, which may offset the positive trend. We can also observe an upsurge of microbial problems among refuse collection personnel.

New jobs are being created with the introduction of the ecocyclic society, *e.g.* in the pre-separation sector. We have reason to believe that these jobs will create major work environment problems in the next few years.

Among other things, the project participants noted that employees with functional impairment and ALU (work experience scheme) workers were being used for preseparation work. It was also observed that the design of the actual pre-separation process was in need of review. The physical environment of work facilities also needs to be improved.

By insisting on a good working environment, municipal authorities can exert partial control over the working environment provided by their contractors. In order, therefore, to ensure the quality of contracted refuse management services, the municipality should take care that the contractor’s working environment is also included on the negotiating agenda. In

addition, the National Board of Occupational Safety and Health must work to ensure that similar demands are made on material companies, in their procurement of services, as regards the working environment of their contractors.

The National Board of Occupational Safety and Health finds it important that the National Environmental Protection Agency should also take work environment aspects into consideration in its documents on the ecocycle and waste management questions, since those documents often form the basis of policy decisions by the Ecocyclic Delegation. The Board finds this important, because ecocyclic questions are dealt with by the Ministry of the Environment and work environment questions by the Ministry of Labour. The Board, then, wants ecocycle questions to be viewed in a more comprehensive perspective than that of the external environment alone.

The Occupational Safety and Health Administration has also given priority to work connected with ecocyclic adjustment in its operational planning.

The vision is for the jobs created as a result of the ecocyclic adjustment of society, for the protection of the external environment, also to be beneficial to the people who carry them out and to not entail risks of ill-health and accidents.

Since beginning of the 1980s waste started to be used as fuel. Today 2.7 million tons of waste is used as fuel and it is planned to increase this to 4.7 million tons. Many, severe accidents have happened with resulting loss of material and equipment and with injured workers. The working environment is also known today to be hazardous for workers' health in these types of production units. A number of fires have started in both storage and production areas with big losses of money for insurance companies as well as for the production companies.

In the field of ***waste handling*** it has been stated by the authorities that collection, handling and separation of non hazardous waste has more than 3 times more reported accidents than average. Reported occupational diseases are double compared with the average.

In the ***wood industries*** where most of the biomass fuel is produced, statistics show 2.5 times as many reported accidents relative to the average. The reported occupational diseases are slightly higher than average.

The Swedish government has announced several new laws to reduce the cost of sick leave and sick pensions because of the rapid growing and large cost for this. The work environment authority has also set up several new codes of practice (Provisions/Ordinance) demanding that employers make risk analyses and risk assessment. The latest is AFS 2003:3 Arbete i explosionsfarlig miljö (Work in an explosive environment)

Looking at the fires happening in the production of energy from waste and biomass fuel it can be difficult to get all the specific statistics but several explosions and fires have occurred in the last 20 years in, for example, Nässjö, Västervik, Södertälje, Umeå, Årjäng. Many fires have been self ignited but others have been caused by electrical short, welding and overheating of equipment. The largest fires in sawmills and pellet factories during 2000-2002 cost the insurance companies more then 195 million SEK (21 million Euro). The total cost of all fires in Sweden for year 2002 is among the highest ever according to statistics over ten years. The cost of the largest fire 1998 in Västervik's production unit was over 30 million SEK.

The Swedish government is discussing a a new law to replace the law of rescue service (Räddningstjänstlagen). More responsibilities will be placed on the owner of real-estate, buildings and production units with regards fire inspections and documentation as well as for reporting fire protection solutions to the local municipality and fire brigade.

RISK ANALYSIS AND RISK ASSESSMENTS

There are ***many different methods*** for risk analysis and risk assessment being used in Sweden today. Most of these methods have their origin at technical universities both in Sweden and abroad. The methods have then been used to do research in different types of industries and been adapted to specific tasks or branches.

The methods have then been published by different organisations or publishers such as Prevent, The Association of Swedish Engineering Industries.

The interesting thing is that the Work Environment Authority has many codes of practice (Provisions/Ordinance) with requirements for employers to do risk analyses and risk assessments but no recommendations for methods. The only requirement is that the risk analyses and risk assessments are done systematically and using a recognized method.

Looking upon the possibilities for preventing not only accidents and occupational diseases but also fires, there is a ***need for using different methods*** and also ***different experts*** when doing risk analyses and risk assessments for the production of energy from waste and biomass fuel.

Furthermore, waste and biomass fuel have ***changing chemical and physical parameters*** depending on the producer, the raw materials, the tax on different waste and fuel *etc*. When these changes are done there is very little done so as to foresee any new risk when handling the “new” waste and biomass fuel.

For example, Igelstadsverken, Södertälje was designed to use coal as the fuel. After some years, the main fuel is biomass fuel and waste. The transport and handling equipment is still the same. The new chief of production was only in charge for a short time when a large fire started in the storage for bio fuel with a large loss of production, equipment as fuel. The chief of production has now decided to make a risk analysis and risk assessment. There are some difficulties for companies who bid for such consultancy work. Which methods and what kind of experts are requested? Few consultancy companies have experts in the fields of working environment, chemicals, environment and fires.

The cost will probably be high for a total risk analysis and risk assessment including safety of machinery, ergonomics, chemicals, physical and biological factors, fire and fire protection.

All this documentation also has to be included in an OSH and Environmental Management System and regularly updated.

EXPERIENCES FROM RISK ANALYSIS AND RISK ASSESSMENT

Energy recovery from waste is environmentally better than land filling. Moreover, it is supported by the coming prohibition against land filling. We will probably see the development of not only recovering of energy from combustible waste but also opportunities for a transition to other biomass fuels if those become economically competitive in the future.

This needs efficient methods for risk analysis and risk assessment which have to cover all factors in the field of occupational safety, health, environment and fire protection. Today we have experiences from different methods which probably can, after some research, be combined to one method adapted to the branch.

INCIDENT REPORTING

Management must allocate resources for the administration, information and motivation for incident reporting. The administration and documentation of incidents can be done effectively with a database. Several databases exist today. The branch should recommend one database to be used by all production units so the result can be combined and compared.

The biggest problem normally is to get the employees motivated. This can be overcome by a strong statement from management and 2-4 hours of training and quick feedback from the incident reports to show that immediate action is taken by management.

OCCUPATIONAL SAFETY AND HEALTH INSPECTIONS

The most traditional methods to investigate the workplace is through OSH-inspections with or without checklists. There are hundreds of checklists in Sweden. Only around fifty are published by different organisations such as Prevent and others. Today's inspections are more effective and involve not only the supervisor and the safety representative but also employees.

Specific and published checklists for the production of energy from combustible waste and biomass fuel do not exist in Sweden. Here is a possibility for the different companies within the branch to get together and work out methods of risk analysis that can be used by many production units instead of each trying to produce their own.

GENERAL RISK ANALYSIS WITH A SIMPLIFIED RISK ASSESSMENT

To get employees involved and to train them to use a simplified risk analysis as well as to make a simplified risk assessment is another very important step to prevent accidents, diseases and fires.

The Joint Industrial Council, (Prevent) has one method called "***Risk thermometer"***. The method has a short instruction booklet which describes in three steps with help of three forms and one checklist what to do. The risk assessment has only three levels. The method makes it possible to describe how the work is done and the different risks which exist in each step of the work and the risk level.

The ***Risk thermometer*** has shown to be very easy to use and can be used for different branches both before the work should start as well as during the work.

I have been introducing the Risk thermometer in all basic training courses for the last five years. Prevent has sold this booklet in more than 4 000 copies.

Prevent has, based on the success of the "Risk thermometer", developed other booklets such as Ergonomic thermometer, Chemical thermometer, Environmental thermometer, and Workplace thermometer (psychosocial factors).

THE METHOD "ENERGY ANALYSIS"

This method, published by The Association of Swedish Engineering Industries, is based on the method to identify where there are different types of energy in a production system. It can be energy caused by electricity, by chemical reaction, by gravity, by movements *etc*. This method is published as a booklet with some forms and checklists. I have used this method and also introduce this method in different training courses. It has been a very useful method and is easy to use.

THE METHOD "RIV-RISK INVENTERINGS VERKTYGET" (THE RISK ANALYSIS TOOL)

This method has been developed for automatic or semi-automatic production. Engineering companies such as SAAB, Volvo and Scania took part in developing the method and are using it regularly.

The method is based on risk analysis and risk assessment in four steps and with 14 different checklists to use if necessary. To be able to use the method requires an experienced leader/supervisor.

I have used the method in one production unit using waste and some other types of factories such as a saw mill, metal workshop *etc*.

It is necessary to plan and allocate both external and internal resources. The results are often very good and the preventive actions and cost for correction or investment is often paid off within 3-9 months.

THE INTERVIEW METHOD "CRITICAL INCIDENT ANALYSIS, CIA"

All the other methods described previously still have to be complemented with an interview method. This method has its origin from manufacturing of aircrafts in USA. Two external resource persons (consultants with different knowledge, an engineer or a psychosocial expert) interview about 20-30% of all the employees. All categories of occupations should be represented. Each interview is done with one employee in a room. The employee has to describe the different steps in the flow of work/production. He or she will be asked by the interviewer about the worst scenario of risk for accident.

The external resource persons then gather all the information in different areas such as chemical, communication, machineries, building *etc*.

The risks are described as well as any proposals for improvements that have been mentioned during the interview. The most important step with this method is to send the compiled information back to each work unit and to have them to discuss how relevant the information is, which risk level and how frequently the risk occurs as well as any proposals to prevent the risk on long or short-term bases.

This method can be used in any type of industrial production but also in hospitals. You need to interview at least 15 people to get a good result. It is a good method in a workplace where there can be tensions between the employer and employees.

RISK ANALYSES AND RISK ASSESSMENT USING DIFFERENT KIND OF FUELS

With solid or liquid fuel there are possibilities to identify different chemical and physical parameters and thereby be able to make a risk analysis and risk assessment.

Working with combustible waste or biomass fuel is different. This kind of fuel consists of domestic waste and comparative waste, yard and garden waste, construction waste, demolition waste, waste from reclamation of products, waste specific from one branch, waste not specific for one branch, special waste, inflammable waste and different kinds of biomass fuel.

The risks for accidents, diseases and fires varies with temperature, humidity, different raw materials and chemical components, which can differ depending on the producer of the fuel, *etc*.

It is necessary that the branch for production of energy from waste and biomass fuel develop a method to evaluate different fuels at the producer's level so the risks can be considered in all steps of handling the fuel.

SUMMARY

The use of combustible waste and biomass fuel for energy production will continue for many years. The negative effects on the environment, loss of production and materials and on human health in this kind of production can be prevented if the branch gets together to **develop a method or methods for risk analysis and risk assessments.**

Another effect is that a lot of human suffering caused by accidents, fires, and occupational diseases can be prevented. Furthermore, production units can run with higher profit with less fire and lower cost for insurance.

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