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ROUND BALING - A NEW TECHNOLOGY FOR STORING AND TRANSPORTING OF WASTE

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INTRODUCTION

The society is demanding that we find long-term solutions to the problem of future waste recycling. It is therefore that, i.e., life-cycle analyses of different products are performed more frequently. Source-sorting and reclamation of waste is now an obvious necessity.

The contribution of BALA Press AB to the rational use of materials and the protection of the environment is a round bale press, a world-patented innovation which revolutionises the handling of waste. Garbage, residual waste and industrial materials can be compressed to a fraction of the original volume and enclosed in cylindrical bales.

THE BALER FUNCTION

The system is based on a patented press design which compresses and wraps the waste into a cylindrical, hermetically sealed bale. The process is completely automized and takes 3-4 minutes per bale. The machine develops a large compressive force with a minimum of energy consumption.

It is available in different versions; stationary or semi-mobile. Today more than 35 press units are in operation in 10 different countries.

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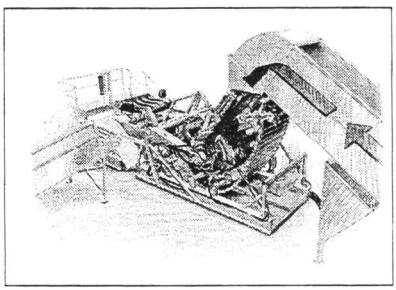
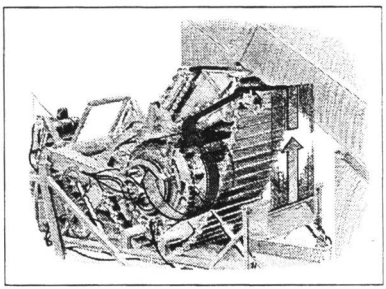
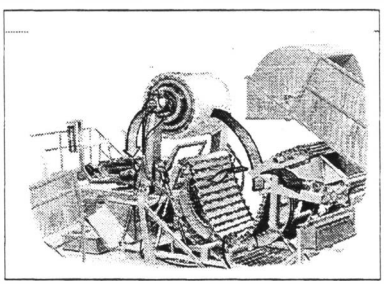
Semi-mobile BALA round bale press



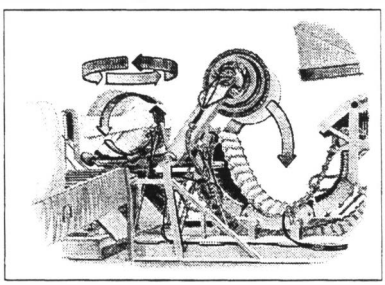
The material is fed into the bale chamber until full pressure is reached.



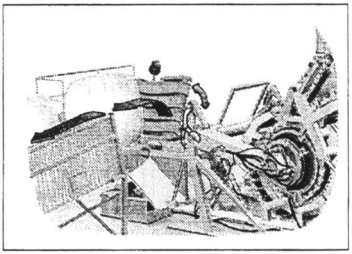
A net or a film is introduced to fix the form of the bale.



The press opens and the bale is lifted to the wrapping unit.



The bale is now wound with stretch film while the press returns to its working mode and begins the pressing of next bale.



The wrapped bale is off-loaded ready for removal to intermediate storage. The process, completely computercontrolled, takes 3-4 minutes per bale.

CHARACTERISTICS OF BALES

A large variety of materials can be baled with the BALA round balers.

After pressing and wrapping, the bale is approximately 1,2 m high and has a diameter approximately 1,2 m. The density of the waste before baling varies naturally in accordance with its constituents. After baling, the volume is reduced by a factor of 2,5 to 4,0 and the bale weight vary dependent on type of material. Typical weights for household-wastes are 600 to 900 kg.

The bales are stackable, which further reduces the storage area required. The number of plastic layers applied to the bales and the UV-resistance of the plastic determines the storage time. Bales have in some cases been stored for two years without any problems. The baling and storage of wrapped bales can preferably be located directly adjacent to the incineration installation or final storage. If the baling is located at a distance from the storage and/or incineration the bales can be transported by ordinary lorries with high transport utilization.

The bales can be opened in different ways when their contents are to be used or incinerated. One method is to crush the bales with a front loader or a similar machine. BALA Press have developed a special bale breaker which also reclaims the netting and plastic wrapping. The burning of baled waste has been experienced positively by the personnel at the incinerator plants mainly because of the uniform energy content of the bales and the preliminary inspection of the material made before the baling.

Bale Weights

Measure: ø 1,2 x 1,2 m, Volume: 1,3 m^3

Material	Weight kg
Corrugated paper	400-600 kg
Mixed board/paper	570-800 kg
Plastic bottles	150-200 kg
Plastic	550-600 kg
Industrial waste	450-600 kg
Tyres, in strip form	800-900 kg
Tyres, whole	550-650 kg
Wood	500-600 kg
Wood shavings	370-420 kg
Wood chips	630-700 kg
Turf	750-950 kg
Silage	700-1 500 kg
Energy grass, Straw	330-450 kg
Household waste with organic matter	800-1 150 kg
Household waste without organic matter	600-700 kg

STORAGE OF WASTE IN ROUND BALES

Degradation processes in the stored waste

Any waste storage involves two different interval processes; aerobic and anaerobic. In the aerobic phase the main degradation is oxidation reactions which produce CO_2. Combustion and thermal degradation can be the consequence of this phase. This period was found to be very short in the case of baling method.

During the anaerobic degradation, three metabolically different groups of bacteria become active and result hydrolytic, acetogenic and finally methanogenic degradations. This biodegradation process by which the organic substances are acting as a nutrient as well as an oxidation agent is a result of co-ordinated action of many different bacteria species in sequential reactions. Any disturbance in such a consecutive system can delay or accelerate some of the biochemical step reactions and affects on degradation rate and energy/mass losses in the stored material (the idea behind baling technique in the below study).

Study of storing waste in round bales

Tests of storing waste in round bales has been carried out both by Lunds University in Sweden as well as DEKRA Umwelt GmbH in Germany.

At the study made by Lund University gas and temperature development, material and energy losses in the stored bales were measured.

The source of waste used in this trial was MSW from Nossebro, Borlänge and Stockholm area. Three different types of waste were stored, RDF (shredded), source separated and unsorted household waste. Organic materials which varies in composition with locations constituted the main fraction.

Results from the study are:

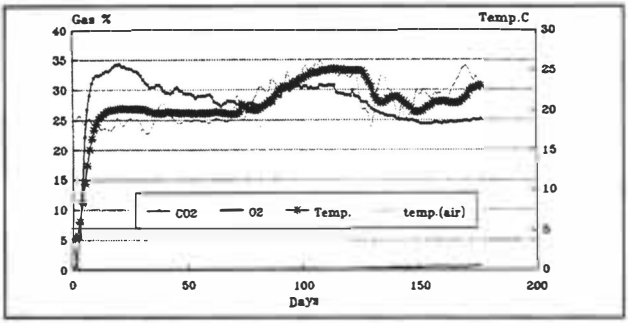
No considerable temperature increase or methane production were observed even after one year and most biological and oxidation reactions were virtually stopped.

In order to study the effect of particle size, shredded household waste was used in the same way. However, formation of methane was not either observed in this case.

The odour emissions accompanying the bale of MSW was found to be mainly the result of production of fatty acids that generated during the early phase of decomposition.

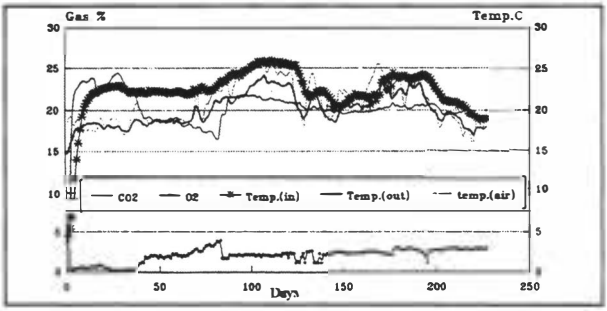
The below graphs shows the gas and temperature development for some of the bales used in the Lunds University study. Also one graph from the DEKRA study is shown as a reference.

Fig. 3: Gas & temperature development in stored waste (MSW), Bale no.N1



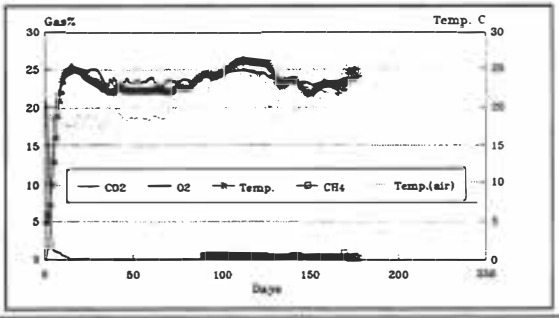
Weight of bale N1 (14.2.95)	976 kg
Total mass loss (8.8.95)	8 kg
Material	Householdwaste
pH in leachate	4.2
pH on surface of waste	5.5
Moisture (wt%)	45

Fig. 4: Gas & temperature development in waste storage (MSW), Bale no.N2



Weight of bale N2 (14.2.95)	914 kg
Total mass loss (8.8.95)	8 kg
Material	Household waste
pH in leachate	4.6
pH on surface of waste	5.5
Moisture (wt%)	45

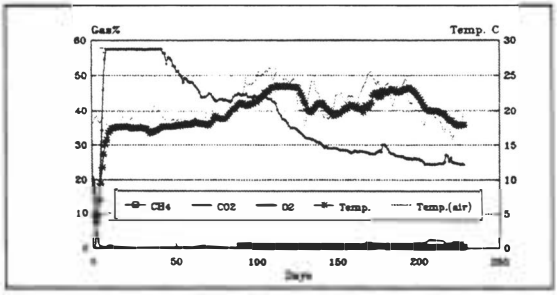
Fig. 5: Gas & temperature development in stored waste (MSW), Bale no.N3 with holes



Weight of bale N3 (14.2.95)	876 kg
Total mass loss (8.8.95)	12 kg
Material	Household waste
pH in leachate	4.9
pH on surface of waste	5.5
Moisture (wt%)	45

Twelve holes with a size of 12x8 cm was made on the lower and upper part of this bale in order to facilitate diffusion of air into the waste material, however, no noticeable effect was observed.

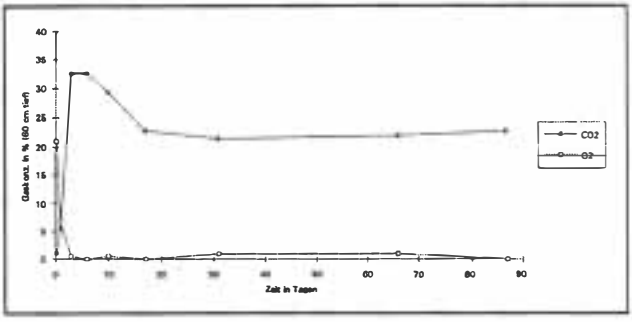
Fig. 6: Gas & temperature development in stored waste (MSW, increased moisture), Bale no.N4



Weight of bale N4 (14.2.95)	1010 kg
Total mass loss (8.8.95)	50 kg
Material	Household waste
pH in leachate	4.5
pH on surface of waste	5.5
Moisture (wt%)	61

The moisture content of this bale was artificially increased by adding water into the waste before baling.

Ballen Nr. 24 (mit Folienabdeckung)



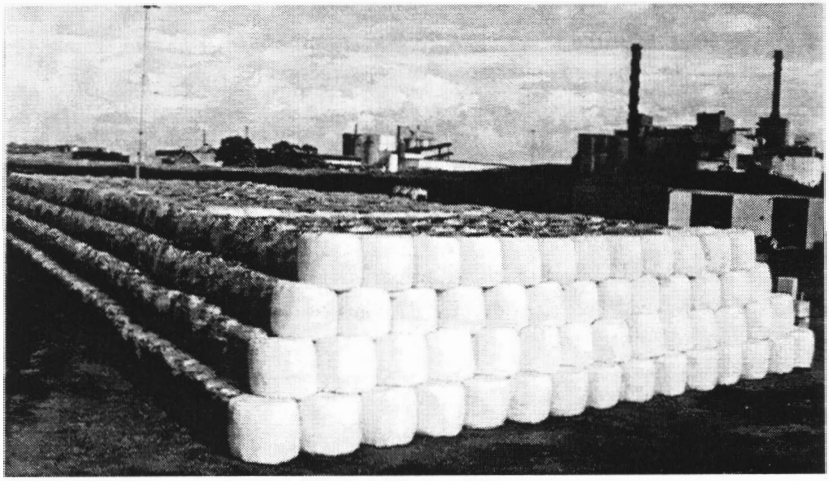
Field experiences of storing waste in bales

The suppliers of district heating in Scandinavia using waste material as fuel in their production are most often dependent on seasonal storage of the waste. The demand for heating is periodic but the volume of waste produced remains constant during the year.

The storage of waste has most often been in the open air. This has resulted in problems with waste flying around, birds, rats and fires. In addition, energy value will be lost by rain penetrating the material and starting a decomposition process. Plants which have not been able to store the summer surplus of waste have most often been unable to use profitably the heat produced from its combustion or have dumped the superfluous material. Baling also allows waste to be delivered to the incinerator plants even during inspection and maintenance shut-downs. Today considerable positive experience has been achieved by full scale baling operations and storages among others at:

	Type of material	Number of bales produced			
		-94	-95	-96	-97
Borlänge Energi Sweden	RDF SS	6 600	8 100	7 400	6 900
GRAAB Gothenburg Sweden	MSW ISW		4 500	28 500	28 000
Umeå Energi Sweden	MSW ISW		11 100	10 000	11 800
Lidköpings Värmeverk Sweden	MSW ISW			6 000	10 500

MSW = Municipal Solid Waste, ISW = Industrial Solid Waste, RDF = Fuel Fraction, SS = Source Sorted



Tekniska Verken Linköping, 11 500 bales produced 1995

SUMMARY

For years of full scale baling operations has proven the technology to be very suitable for storing of waste by:

- no fermentation
- preservation of material properties, almost no energy and mass loss
- less smell
- less fire risk, no risk for selfignition
- clean and tidy storage and transportation
- reduced volume
- higher energy value, due to water tight storage
- outdoor storage possibility

economically and environmentally good when seasonable variations are even out at waste to energy plants.

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Praktisk erfarenhet med lagring av brännbart avfall i ett svenskt avfallssällskap (Experience from storing of burnable waste in a Swedish waste management, Carl-Arne Pedersen, GRAAB, Gothenburg association

Storage of waste-Fuel by baling technique, Feraydoon Tamaddon and William Hogland, Lund University

Zwischenbericht zum Pilotversuch für Abfallzwischenlagerung
Manfred Faykes and Tom Scheidl, DEKRA Umwelt GmbH

GRAAB recovery station at Tagene, Gothenburg with a storage of 28 000 bales 1997.