

## COMPOSTING INDUSTRY SITUATION IN TURKEY AND EU STATES

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### ABSTRACT

Volume of municipal and agricultural wastes is increasing, because of the increase in the country's population and changes in lifestyle form, from 15 million tones in 1991 to 23.7 tones in 2002 in Turkey. Turkey's municipal solid waste generally consists of wastes generated from residential and commercial areas, industries, parks and streets, and is not sorted at the source, but collected in the same waste bins. Composting plant have been installed in some cities while in other centers disposal practices varies from landfilling to dumping in quarries, stream and even the sea. The adaptation process to EU improved the importance of composting for Turkey. For example; Istanbul Metropolitan Municipality is the biggest composting plant in Europe and it has operated since 2001. The most European countries have developed own compost industry because they are forced by EU directives.

This paper evaluates the current state of the composting industry in Turkey and also compares the performance and profile of different composting plants with that of EU countries.

### INTRODUCTION

The disposal of organic wastes is an increasing problem in the world and our country. Landfilling, composting, incineration, and recycling constitute the alternatives of solid waste removal. Degreasing the volume, mass, and the removal cost of solid wastes are the main purposes of solid waste elimination studies. Composting, by which the organic materials are processed biologically, is one of the methods that is used for this target. Compost is used in agriculture, forestry and horticulture. A phenomenal increase has been occurred in biological waste treatment in Europe recent years. Investigations indicated that at least 35 percent of urban wastes and large portion of industrial residuals could be biologically treated via composting and/or anaerobic digestion. This recoverable organic fraction is about 49 million metric tons per year equal to 40 percent of the total waste production in Europe (1).

Production of municipal and agricultural waste is highly in relation with economic development of the country. Composting seems to be an important element in sustainable waste management for Turkey, because only 0,45% of the residential waste had been composted in 1996 (2). There is only three large-scale composting plant, one of them is the Istanbul Metropolitan Municipality Plant operated since 2001. This plant is the biggest composting plant in Europe and it shows that importance of composting is increasing in Turkey.

### COMPOSTING IN EUROPE

#### The Directive 99/31/CE on Landfills

The directive 99/31/CE on landfills provides for the landfilled biowaste to be sharply reduced within next years. This directive is purposed reducing the production of biogas effectively at landfilling sites and improving the conditions at which landfills get operated. The targets sets by the landfill directive are set out in Article 5 of the directive and require the following (3):

- Not latter than 16 July 2006, biodegradable municipal waste going to landfill must be reduced to %75 of the total amount by weight of biodegradable municipal solid waste produced in 1995.
- Not latter than 16 July 2009, biodegradable municipal waste going to landfill must be reduced to %50 of the total amount by weight of biodegradable municipal solid waste produced in 1995.
- Not latter than 16 July 2016, biodegradable municipal waste going to landfill must be reduced to %35 of the total amount by weight of biodegradable municipal solid waste produced in 1995.

In order to achieve this, biological treatment and composting are plays a major role in this respect; composting is also the most "natural" way to manage biowaste.

### Composting Industry Situation in EU States

The collected and treated amounts of organic matter are different in the EU countries. Approximately 17 million tones bio and green wastes separately collected and treated in total recoverable potential of the 49 million tones biowaste (1). The overall of food and green waste compost production within the EU is 5000000 t/y approx. Germany, Austria and The Netherlands are the leading countries in the compost production as well as in the enhancement of strategies to promote it (4).

The organic waste activities in Europe can be divided into 4 categories. The policy in Austria, Belgium (Flanders), Germany, Switzerland, Luxembourg, Italy, Spain (Catalonia), Sweden and the Netherlands is countrywide implemented. These countries of the first category recovers around 80 percent of the separately collected and treated (mostly by composting) organic waste fractions in the EU. Digestion also plays a minor part at the moment. Denmark, UK and Norway forms the second category of the implementing states. These countries have built up the parts of the political, quality and organizing framework for separate collection and composting. Finland and France forms the third category, and developed strategies at the starting point. In the fourth category we find countries where no effort on composting of source separated organic waste like Spain, Greece, Ireland and Portugal. These countries still compost mixed urban wastes (6).

Table 1 Compost production in the European Union (4).

EU Countries	Compost Production (10 <sup>3</sup> t/year)	Compost Production (10 <sup>3</sup> m <sup>3</sup> /year)	l/inh./year
Austria	500	909	113.2
Denmark	250	454	87.1
The Netherlands	650	1181	76.9
Germany	2400	4363	53.5
Belgium (Flanders)	200 (180)	363 (327)	35.8 (55.7)
Sweden	100	181	20.5
Luxembourg	3	5.45	14.2
Finland	30	54	10.6
Italy (Northern Italy)	250 (200)	454 (363)	8.1 (14.7)
France	240	436	7.7
United Kingdom	159	289	4.9
Greece	/	/	< 1
Ireland	/	/	< 1
Spain	/	/	< 1
Portugal	/	/	< 1
Total	4782	8694	23.5

#### Norway

Norway has 33 composting plants with capacities between 300 t/y and 25,000 t/y. Simple windrow composting plant is used by farmers (1,500 t/yr). This approach is expected to become more common for farmers beginning to commit themselves to composting. Three more similar facilities are planned in southern Norway (6).

#### Sweden

In Sweden a decision made by the Parliament in 1998 showed that landfilling of organic wastes will not be allowed after the year 2005. Sweden compost production is about 100000 t/y from biowaste and 100000 t/y from greenwaste. Trends towards high technology standards in composting. Composting Plants in Sweden is especially built in dense populated areas. These technologies range from forced aeration of membrane covered windrows to modern tunnel composting plants (6). Sweden have 100 greenwaste composting plants at near landfills, and operates based on windrow technology (6).

#### Finland

Approximately 80000 tons of biowaste are treated in centralized treatment plants in Finland. This amount is 10% of the total amount of organic waste. According to the Waste Management Plan (1998) and its recycling target of 70 % of the organic part in MSW, the total number of centralized biowaste treatment plants is going to be raised from about 5-10 to 40-50 by the year 2005 (7). Organic wastes are generally treated by composting in Finland. There is only one anaerobic digestion plant, which treats about 25.000 tons of biowaste and 15.000 tons of sludge annually (7).

#### Denmark

Denmark has 5 million inhabitants, generating 12 million tons of waste a year (8). Denmark have low reliance on landfill and employs a range of treatment options for the management of BMW (Biodegradable Municipal

Waste). In 1998 5.3% of BMW was consigned to landfill, 54.3% to incineration with energy recovery, 29.6% to composting, 10.4% to recycling and 0.4 to anaerobic digestion (9). Denmark has 5 biogas and 134 compost plants. These plants treat 37000 tons of organic household waste and 615000 tons of garden and park waste. The composting plant in Denmark produced 388000 tons of compost in 1999 (7).

### ***Great Britain***

50 compost plants operate in Great Britain, of which two have a production of more than 25 000 t/y. A tunnel composting system started with the capacity of 16000 t/y of garden waste, dewatered sewage sludge and sugar beet residues in Suffolk. There is also a prototype container composting system. Most other facilities in the UK utilize open windrows (6). Tunnel and box composting systems are becoming the favored technology. This new trend mostly is based on bad experience with odors and experiences from central Europe (6)

### ***Netherlands***

About 92 percent of the households are connected to a separate waste collection system in the Netherlands (16 million people in approximately 6 million households). The separate collection system for organic wastes results in 1.57 million tons of biowaste being processed into 0.6 million tons of compost (10). Netherlands has 26 composting plants for domestic biowaste with a total capacity of 1.57 million tons (6). There is only two anaerobic digestion plants in Netherlands and has a total capacity of 88000 t/y. A further anaerobic plant processes the organic fraction of residual waste; another for so-called biological mechanical pre-treatment is in the planning phase (7).

### ***Belgium***

Seven composting and one anaerobic digestion plant are operational in Flanders. The treatment capacities of these plants are between 35000 and 60000 t/y. While five of the composting plants operate based on closed hall method, the others operate based on box and tunnel method. Flanders has only one digestion plant with a capacity of 35000 t/y. A second digestion plant will be in progress in 2003. Separately collected biowaste (340.000 t or almost 60 kg/inhabitant.y) and green waste (460.000 t or some 78 kg/inhabitant.y) accounted for about 25% of the total amount of collected MSW (2001) (7).

The green waste is composted in open air windrows, on a hardened floor, with collection and re-use of leachate. Aeration is obtained by regular turning of the compost material. In some cases, aeration tubes are installed in the floor to allow active aeration of compost piles (6).

### ***Germany***

7 to 8 million tons of wastes are collected separately in Germany at the moment. The whole potential of organic raw material amounts up to 9 million tons. About 60-75% of all the inhabitants use in source biowaste separation system in 2001 (7). Approximately 700-900 composting plants are in operation in Germany between 1990 and 2001. These plants produce 4 million tons of compost products. While 80 percent of the composting plants work with heaps or windrows, 10 percent use boxes, three percent use enclosed, aerated metal containers; three percent utilize continuously revolving decomposition drums; another three percent use a channel system with aerated side-by-side rows, separated by concrete walls, or tunnels (basically covered channels) (11).

There are 500-800 anaerobic digestion plants in operation in Germany. While the most of these anaerobic digestion plants use agricultural wastes, only a few use co-digest biowaste. Around 37 large industrial digestion plants treating pure biowaste, with a capacity 500000 t, 20 of them are the member of the voluntary quality assurance system of the Quality Assurance Organization BGK (11).

### ***Luxembourg***

41 percent of the 430.000 inhabitants in three large inter-municipal associations are connected to source separation system at the moment in Luxembourg. Luxembourg has three composting plants and its total treatment capacity is around 27000 t/y and also there is another three in project phase. Anaerobic digestion and mechanical-biological-pretreatment activities are not used in Luxembourg (7).

### ***France***

70 composting plants treat mixed MSW and the average treatment capacity of these composting plants is around 3.1 million tons. They produce about 1.5 million tons of compost products (7). In France, approximately 40 green waste windrow composting plants are processing 400 000 t/y. There is unknown number of smaller plants (2000 to 3000 t/y) (6).

### ***Austria***

80 percent of the households were involved in the separate collection system, generating 1.1 million t/y of biowastes (5). Only about 11% may be addressed as organic wastes in a narrower sense for biological waste

treatment (12). More than 50 percent of this is composted in small facilities (<5000 t/y) owned by farmers and municipalities. For greenwaste, generation of around 620000 t/y can be assumed (7). There are only three industrial biogas plants for organic household waste with total capacity of 45000 t/y (12,000, 13,000 and 20,000 tonnes respectively) (7). Austria has more than 500 organic waste composting plants with an overall capacity 760 000 t/y. In 2000 the actual quantity of processed biowaste amounted to 610 000 tonnes (13). 50 percent of composting plants have a capacity of less than 500 t/y. As with another 100 plants with an annual capacity of less than 2000 t/y, composting mostly is done in windrows. Twentyone other plants processes between 2,000 and 5000 t/y. Only 14 of Austria's composting plants have a capacity of over 5000 t/y. Static windrow composting, forced aeration, box composting and rotating drum systems are used in addition to turned windrows (6).

### ***Switzerland***

Around 80 percent of source separated organic waste composted in open windrows with capacities between 100 and 20000 t/y. The larger plants operate based on the forced aeration. A large enterprise (ROM) with mobile technology supervises many decentralized windrow composting plants and thus responsible for processing 50000 to 60000 t/y of organic materials (6).

### ***Italy***

Municipal solid waste are generally landfilled in Italy, 74.4 percent of total MSW was landfilled in 1999, mainly without any pre-treatment, while source separation and recycling averaged 13,1 % of national MSW production (7). However, a February, 1997 law sets a target of 35 percent source separated collection of organics by 2003 (6). The number of composting plants in Italy increased from 10 in 1993 to 114 in 1999 (135 plants considering also sites with a capacity of less than 1000 tonnes per year) (5). These plants are treating principally organic waste from source separation of MSW (food and yard waste). The average size of the plants is relatively small, around 10.000 tonnes (75 plants); where as 37 plants treat between 10.000 and 30.000 t/y. Recent facilities anyway most frequently show a capacity above 30.000 t/y (18 plants); Region Veneto (which has the highest capacity, more than 500.000 tonnes, i.e. more than 100 kg/inhabitant) shows most frequently a different pattern, with some facilities between 50.000 and 100.000 tonnes (7).

### ***Portugal***

No activities regarding separate collection and composting of organic wastes are known in Portugal. Nonetheless, some facilities for mixed MSW have long been running (5 plants with 400.000 t capacity, their capacities will be enlarged to 480.000 t/y in 2002). Lately, some facilities to tackle source separated organic waste (e.g. from big producers) have been planned and/or are being constructed. Also some of the old facilities are planned to be partially upgraded into quality composting sites for source separated organic waste (7).

### ***Ireland***

Almost all the organic components collected with MSW (92 %) and commercial waste are landfilled in Ireland at the moment. A number of home composting schemes have been set up by local authorities, with eight of such projects received funded until 1999. Currently Ireland has no significant biological waste treatment capacity. Two of the four centralized composting plants treat only greenwaste, the others separated treats kitchen waste. Further considerable development of centralized composting for organic waste is strongly recommended by the EPA (2000) (7).

### ***Spain***

Spain has a windrow composting plant with forced aeration and a capacity of 25000 t/y located in the center of Madrid, 500 meters from the Government Palace. It is expected to treat green residues from public parks. There is a work on very big plant (260000 t/y) in La Coruna, which will be in operation in 1999. It will utilize mechanical-biological treatment, composting and digestion (6).

### ***Greece***

The overall production of MSW in Greece is estimated around 4.000.000 tons for the year 2000. Until 1994, waste disposal was characterized by the thousands of dumpsites (4850 were recorded officially), 70% of which were uncontrolled (corresponding to 35% of the total waste quantities). The proportion of the population served by regular collection system was around 70%, while in numerous small islands and isolated villages collection was poorly organized (7). In Greece, apart from some pilot projects, composting activities are limited to the construction of MSW composting plant for the city of Athens. It is sponsored by the EU and will have a capacity of 100000 t/y (6).

## COMPOSTING INDUSTRY SITUATION IN TURKEY

### Organic Waste Potential in Turkey

Turkey's Municipal waste potential is about 65 000 tons per day (14). Organic components collected with MSW and commercial wastes are generally landfilled in Turkey. While 31,75% of the total amount of daily collected garbage were disposed at the main city dump, 42,83% at the municipality dump, 2,35% at the other municipality's dump, 12,76% at the sanitary landfilling (only six municipalities have sanitary landfills), 0,45% at the compost plant, 1,96% at the open combustion, 0,02% at the rivers, seas and lakes in 1996 (2). Turkey has over 2000 open dumps. Open dumping means that solid wastes are just dumped without any precautions being taken. They are neither compacted nor covered, they have no systems to deal with leachate or methane gas collection, and they pollute the environment continuously. They encourage both insects and vermin to breed, and endanger public health and safety. Serious accidents, such as the methane explosion at the Ümraniye Open Dump, Istanbul, in April 1995, which killed 39 people, or the slippage of a huge mass of solid waste from the Kemerburgaz Open Dump (also at Istanbul) onto the neighbouring road in May 1996, demonstrated the significant threat of this method. Such open dumps should be closed immediately and/or rehabilitated, in order to avoid yet more severe accidents in the future.

Approximately 32 000 tons of dry matter animal manure, 110 000 tons of dry matter plant (vegetable) wastes produced per day, while 486 000 tons of slaughterhouse wastes, 1 410 000 tons of milk processing wastes and 86 000 tons of olive oil mill wastes were produced annually in Turkey. Agricultural wastes generally burned or buried by farmers so, agricultural wastes have an important role in environmental pollution.

By the time the Solid Waste Control Regulation of Turkey published in 1991, the municipalities had started to stop using and/or rehabilitate the existing open dumps, and construct sanitary landfills according to the new standards. This regulation permitted only three waste disposal method. These methods are sanitary landfill, composting and incineration for energy production.

### Composting in Turkey

Composting seems to be an important method in sustainable waste management for Turkey, because only 0,45% of the residential waste was composted in 1996 and also there is only three large-scale composting plant in 2002. The first composting plant was built in Izmir and operated since 1969. Its capacity is 250 t MSW/day and it produces about 100 t compost per day at the moment. Composting facilities are processed by the technologies with DANO-Biostabilisation, which transferred from Denmark. There are two DANO Composting units has a batch capacity of 75 t. It is possible to increase to 150 tons per day for 8 hours retention time. In DANO –Drums, the temperature raises to 55-65° C in a short time period and aerobic degradation begins rapidly. The compost heaped for 2-3 months period is ripe and can be sold as humus material for soils (15).

The second composting plant was built along the western coastal zone of Antalya in Kemer and operates since 1999. Most of the 4 million foreign tourists spends their vocation in this region. Therefore, Kemer region has a higher degree of importance for Turkish economy. This plant has a capacity of 50 000 t/y and brokolare composting system. It also produces 12000 t compost per year (16).

In order to solve the solid waste disposal problem, which is one of the main scopes of the Southern Antalya Tourism Development Project, a composting plant is constructed in the near vicinity of Kemer city. The plant was built on an area of 12000 sqm. Kemer composting plant is fully equipped with air-conditioning unit with a capacity of 12000 cubic meter air. The source separated wastes are also separated manually in the composting plant. Separated organic wastes are mixed with green material and then pressed to form briquettes. The briquettes are placed in maturation rooms and kept in for 2-3 weeks to achieve the decomposition of the wastes. At the end of the maturation period, compost product is screened by rotary sieves, packed for marketing (16).

The third composting plant, which has a capacity of 1 000 tons per day, is located at Kemerburgaz region, European side of Istanbul. Istanbul Metropolitan Municipality has been operating this plant since 2001. It produces 250 t compost per day. This plant is the biggest composting plant in Europe. Approximately 10000 tons of MSW per day are produced in Istanbul Metropolitan city. MSW is mainly treated by landfilling and composting in Istanbul now. While about 10% of the total amount of MSW are being disposed by composting, the others by sanitary landfills (17). Capacity of Istanbul Solid Waste Composting and Recycling Plant planned according to the following values;

Average moisture content	55 %
Organic matter	45 %
Total solid waste quantity	300000 tons/year
Solid waste quantity of fermentation unit	150000 tons/year
Composting time	56 days
Compost quality	According to 4 M-10* standard compost temperature is 30-40°C

\* - LAGA (Landerarbeitsgemeinschaft Abfall) Merkblatt M10 (German compost quality standard 1997)

Composting unit in the plant is 230 m in length and 35 m in width. This unit is separated into two sections: primary and secondary decomposition part. Primary section is completely covered by stainless steel and retention time is 3 weeks, while this time is 5 weeks in secondary section. Air passes through the piles of the second decomposition part, and then this air is used for aerating the piles of the primary section. Aeration time and aeration degree could be adjusted automatically. Technical information about the decomposition unit were given in Table 2 (18).

Table 2. Technical information of Istanbul Solid Waste Composting and Recycling Plant

Parameter	Characteristic
Operation time	8 weeks (7 transfer operations)
Number of decomposition areas	2 lines (each line consists of 8 areas)
Pile height	2,5 m in regular operation (peak height is 3m)
Mixing width	31m (maximum)
Aeration of 1-3 area	Compressed aeration
Aeration of 4-8 area	Absorbed aeration
Aeration of 2-8 area	Moisture addition during mixing

## CONCLUSIONS

Management of solid wastes still continues to be a problem around the world. Since handling and disposal of solid waste is an expensive process, most countries are trying to minimize the generation of solid waste. It is also possible to evaluate this valuable component as a source of energy production.

European countries are making great efforts to treat organic waste streams as far as possible with biological means. The trend generally favors separate collection and composting or digestion of organic wastes from households, gardens and public parks. Increasing environmental protection requirements, market forces and laws do not permit other alternatives.

Composting plants are installed in some cities of Turkey while in others disposal practice varies from landfilling to dumping in quarries, stream and even the sea. Compost production is not enough in Turkey and new composting plants should be installed. But composting plants in Turkey are being made a loss because Turkish farmers do not use to compost as a fertilizer and/or soil conditioner.

In conclusions;

- Turkish farmers should be educated about benefits of compost as a fertilizer and/or soil conditioner,
- Composting of solid wastes should be encouraged in rural areas,
- New composting facilities should be installed,
- Cost-benefit analyses should be made before deciding to construct composting plants,
- Household wastes should be connected to a separate collection system,
- The directive 99/31/CE on landfill target should be addressed to Turkey's solid waste management.

## REFERENCES

- 1- Bionet, 2002. Biological Waste Treatment in Europe Technical and Market Developments. <http://www.bionet.net/de/waste/index.htm>
- 2- Die (The national Institute of statistics of Turkey), 2000. Results of municipal survey of environment in Turkey in 1996. [www.die.gov.tr/TURKISH/SONIST/CEVRE/cevre.html](http://www.die.gov.tr/TURKISH/SONIST/CEVRE/cevre.html)
- 3- Council Directive 1999/31/EC of 26 April on the landfill of waste. Official Journal L.182, 16/07/99 p 0001-0019.
- 4- Centemore, M., Ragazzi, R., Favoino, E., 1999. Label Policies, Marketing Strategies and Technical Developments of Compost Market in The European Countries. International conference of biological treatment and environment 2nd-4th September 1999 Welmar, Germany, p. 355-363.
- 5- Favoino, E., 2003. Composting Across Europe. <http://www.hua.gr/compost.net/Favoino%20,%20composting%20across%20Europe.pdf>
- 6- Barth, J., Kroger, B., 1998. Composting Progress in Europe. Biocycle International, April 98, V.39, issue 4.
- 7- Country Reports, 2003. <http://www.compostnetwork.info/countries/index.htm>.
- 8- Veltze, S. A., 2002. Managing without landfill - The Danish example. Waste Management World. V.2, N.1.
- 9- Crowe, M., Nolan, K., Collins, C., Carty, G., Donlon, B., Kristoffersen, M., 2002. Biodegradable Municipal Management in Europe. European Environmental Agency report.
- 10- Ouwerkerk, H. 1999. Waste management in the Netherlands. European Conference on Waste Management Planning,

- 11- Hogg, D., Barth, J., Favonio, E., Centemero, M., Caimi, V., Amlinger, W., Devliegher, W., Brinton, W., Antler, S. 2002. Review of Compost Standards in Germany. The Waste and Resources Action Programme (WRAP) report, ISBN:1-84405-011-4.
- 12- Amlinger, F., Peyr, S., Geszti, J. 2001. Compost Management in Austria-Quantities and Qualities. 15th-17th May Biowaste Conference, Pt.Pölsen, Vienna.
- 13- Country Reports, 2001. Organic waste treatment plants in Austria 15th-17th May Biowaste Conference, Pt.Pölsen, Vienna.
- 14- Ministry of Environment of Republic of Turkey, 2002. Solid waste. [www.cevre.gov.tr](http://www.cevre.gov.tr).
- 15- Erdin, E. 2002. Composting Factory in İzmir. <http://erdin.deu.edu.tr/pubs.htm>.
- 16- Kurt, P. B., Topkaya, M. B., Özden, T., Güney, N. 2002. Composting experience and practice in Antalya Province. Appropriate Environmental and Solid Waste Management and Technologies for Developing Countries Symposium, Istanbul, p. 1337-1344.
- 17- Demir, A., Tosun, I., Özkaya, B., Bilgili, M. S., Günay, A., Avşar F., Karaaslan, Y. 2002. Aerobic composting of municipal solid waste in Istanbul: Start up and operational experiences. Appropriate Environmental and Solid Waste Management and Technologies for Developing Countries Symposium, Istanbul, p. 1329-1336.
- 18- Demir, A., Baştürk, A., Karaaslan, Y., Özkaya, B., Debik E., Bayhan, H., Kanat G. 2002. Composting process and the product quality in Istanbul composting and recycling plant. Appropriate Environmental and Solid Waste Management and Technologies for Developing Countries Symposium, Istanbul, p. 1321-1328.