WASTE GREASE RESOURCES IN 30 US METROPOLITAN AREAS

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ABSTRACT

Data were collected in 30 randomly selected metropolitan areas in the United States on the amounts of yellow grease feedstock gathered by rendering companies from restaurants, and grease trap waste recovered or entering sewage treatment plants. The metropolitan areas ranged in size from Bismarck, North Dakota (83,83 1) to Washington, DC (3,923,574). Yellow grease feedstock is a valuable commodity, and as such its availability as a feedstock for biodiesel production is questionable. Grease trap waste is a zero or negative cost feedstock, but is contaminated with sewage components. This study did not address feedstock preparation and cost issues. Despite high local variations among neighborhoods' grease outputs, when entire metropolitan areas are considered the quantities of grease are reasonably consistent on a per capita basis.

Keywords: grease, waste grease, yellow grease, biodiesel

OVERVIEW

This study, which was funded by the US Department of Energy's National Renewable Energy Laboratory (NREL), collected and analyzed data on urban waste grease resources in 30 randomly selected metropolitan areas in the United States. The metropolitan areas ranged in size from Bismarck, North Dakota (83,831) to Washington, DC (3,923,574). Two major categories of urban waste grease were considered in this study:

1) yellow grease feedstock collected from restaurants by rendering companies; and
2) grease trap wastes from restaurants, which can either:
   a. be pumped into tank trucks for disposal (often at wastewater treatment plants) or processing (at rendering plants or other facilities); or

b. flow through municipal sewage systems into wastewater treatment plants.

Yellow grease feedstock is a valuable commodity, and as such its availability or value as a feedstock for biodiesel production is questionable. Grease trap waste and grease entering sewage treatment plants are zero or negative cost feedstocks at their sources, but are contaminated with sewage components. Other than collecting information on tipping fees, this study did not address feedstock preparation and cost issues.

The number of restaurants in most of the 30 metropolitan areas studied is quite consistent, at about 1.4 restaurants per 1,000 people. Cultural and dietary preferences greatly affect the amount of grease used in cooking. The amount of grease discarded from certain fast food restaurants is especially high. Despite significant local variations among neighborhoods' grease outputs, when entire metropolitan areas are considered the quantities of grease are reasonably consistent on a per capita (and a per restaurant) basis.

The amount of yellow grease feedstock collected from restaurants ranged from about 1.4 to 9.5 kilograms/year/person (3 to 21 pounds/year/person), or about 900 to 5,900 kilograms/year/restaurant (2,000 to 13,000 pounds/year/restaurant) for the metropolitan areas sampled in this study. Many rendering companies refused to provide data, so factored estimates were used in many of the cities. The combined resource of collected grease trap waste and uncollected grease entering sewage treatment plants ranged from about 1.8 to 22 kilograms/year/person (4 to 48 pounds/year/person), or about 1,400 to 11,000 kilograms/year/restaurant (3,000 to 24,000 pounds/year/restaurant). Thus, a metropolitan area the size of Washington, DC (which includes suburban Maryland and Northern Virginia) generates about 18,000,000 kilograms/year (39,000,000 pounds/year) of yellow grease feedstock and about 23,000,000 kilograms/year (50,000,000 pounds/year) of grease trap waste.

Table 1 summarizes the data collected in this study on a per capita basis, in kilograms of grease per year, per person. The table also shows the metropolitan area populations and the number of restaurants per 1,000 people in each area. The numbers in front of the metropolitan areas represent the order in which the areas were visited. City names followed by dashes indicate that additional cities are included in the official name of the metropolitan area (e.g., Provo-Orem).

There is not much variability from one urban area to another in the number of restaurants per 1,000 people. The number is between 1 and 2 for all 30 cities, and usually in the middle of this range, with a weighted average of 1.41 restaurants/l,000 people. Regression analysis shows that the best fit line has a coefficient (slope) of 1.36 restaurants/l,000 people, with an r-squared value of 0.985. Based on this finding, we would expect that the number of restaurants and the number of people in a metropolitan

Table 1
Waste Grease Resources in 30 Metropolitan Areas, Kilograms/Year/Person

No	Metro Area	State	Population	Rstrnts /1000P	Yellow Grease	Trap Grease	Total Grease
1	Sacramento	CA	1,481,102	1.49	1.38	2.05	3.43
2	Olympia	WA	161,238	1.49	3.04	3.38	6.41
3	Provo-	UT	263,590	1.52	7.54	12.04	19.58
4	Denver-	CO	1,848,319	1.44	4.17	6.33	10.50
5	Lincoln*	NE	213,641	1.64	9.55	9.76	50.10
6	Bismarck	ND	83,831	1.59	2.33	2.16	4.49
7	Bloomington-	IL	129,180	1.55	1.76	9.83	11.59
8	Battle Creek	MI	135,982	1.55	5.00	9.10	14.11
9	Mansfield	OH	126,137	1.93	2.34	3.20	5.54
10	Elmira	NY	95,195	1.47	4.53	6.43	10.96
11	Boston	MA	1,950,855	1.54	2.42	15.34	17.76
12	Harrisburg-	PA	587,986	1.53	4.63	8.33	12.96
13	Altoona	PA	130,542	1.10	4.52	3.47	7.99
14	Hagerstown	MD	121,393	1.40	4.48	3.74	8.22
15	Washington	DC	3,923,574	1.27	4.51	5.78	10.29
16	Richmond-	VA	865,640	1.71	4.56	10.22	14.77
17	Danville	VA	108,711	1.44	4.59	7.93	12.52
18	Fayetteville	NC	274,566	1.40	4.46	3.47	7.93
19	Florence	SC	114,344	1.62	4.36	3.57	7.93
20	Greenville-	SC	640,861	1.59	4.53	8.56	13.09
21	Lexington-	KY	348,428	1.61	4.56	5.99	10.54
22	Memphis	TN	981,747	1.15	4.53	12.70	17.23
23	Decatur	AL	131,556	1.86	4.48	16.55	21.03
24	Macon-	GA	281,103	1.24	4.52	21.78	26.30
25	Lakeland-	FL	405,382	1.10	4.59	9.40	13.98
26	Bradenton	FL	211,707	1.70	4.50	11.57	16.07
27	Baton Rouge	LA	528,264	1.24	4.55	9.10	13.65
28	Shreveport	LA	334,341	1.32	4.48	6.38	10.85
29	Beaumont-	TX	361,226	1.06	4.52	4.90	9.42
30	Bryan-	TX	121,862	1.62	4.47	7.44	11.91
	Weighted average			1.41	4.02	8.13	12.54

*Lincoln total includes 30.78 kilograms/year/person of food plant waste grease.

area give about the same ability to predict the quantities of waste grease resources in that area. Regression analysis showed that this is indeed the case, as summarized in Table 2.

The population of a metropolitan area, state, or other geographic area is generally easier to obtain than the number of restaurants in that area. Rounding off to reflect a reasonable

Table 2
Grease Resources vs. Population and Number of Restaurants

	Yellow Grease	Trap Grease	Total Grease
vs. Population			
Weighted average, kg/year/person	4.02	8.13	12.54
Regression coefficient, kg/year/person	3.96	7.38	11.39
R squared	0.901	0.694	0.828
vs. Number of Restaurants			
Weighted average, kg/year/restaurant	2,843	5,750	8,867
Regression coefficient, kg/year/restaurant	2,837	5,461	8,341
R squared	0.849	0.727	0.837

number of significant digits, the urban waste grease resources of a metropolitan area, region, state, or the US as a whole can be predicted from the following simple equations:

- Yellow grease = 4 kilograms/year/person (9 pounds/year/person)
- Trap grease = 7 kilograms/year/person (16 pounds/year/person)
- Total waste grease = 11 kilograms/year/person (25 pounds/year/person)

YELLOW GREASE

Rendering companies process grease and fat from restaurant kitchens, and produce tallow (most of which is exported to the Orient) and feed fat for use in animal feed. Prices for yellow grease fluctuate as with all commodities, but recently have been in the 33-44¢/kilogram (15-20¢/pound) range. Waste grease from restaurants appears to be growing in economic value and is the focus of intense competition in some cities. Some of the rendering companies are major companies with nationwide or large regional operations. The companies I encountered most often in the 30 metropolitan areas studied were:

- Valley Proteins, Inc. -- in nine metropolitan areas in the eastern US (Harrisburg, Altoona, Hagerstown, Washington, DC, Richmond, Danville, Florence, Greenville, and Lexington);
- Darling International, Inc. -- in eight metropolitan areas throughout the US (Olympia, Lincoln, Battle Creek, Lakeland, Baton Rouge, Shreveport, Beaumont, and Bryan);
- Griffin Industries, Inc. -- in seven metropolitan areas in the south (Memphis, Decatur, Macon, Lakeland, Bradenton, Baton Rouge, and Shreveport);

- Baker Commodities, Inc. -- in three metropolitan areas in the north (Olympia, Bismarck, and Boston);
- National Byproducts Company -- in Denver and Lincoln; and
- CBP Resources Inc. -- in Richmond and Fayetteville.

In addition, I encountered at least 23 other rendering companies in one metropolitan area each. The grease collection business in Provo-Orem, Utah is typical of those in many of the other metropolitan areas studied. Bonneville Livestock Inc. collects and processes about 55-60% of the restaurant grease in Utah, and also operates in four or five nearby states. Its manager described a competitive business, with John Kuhni & Sons, American Commodities Co., and Renegade Oil Co. all vying for restaurant accounts in the Provo-Orem area. The manager at John Kuhni & Sons stated that Renegade Oil Co. in Salt Lake City is his biggest competitor. In the Provo-Orem area, John Kuhni & Sons picks up, on average, about two barrels every three weeks from about 70-75 restaurants. Assuming an average of 136 kilograms (300 pounds) of grease per barrel, this is equivalent to about 4,500 kilograms/year/restaurant (10,000 pounds/year/restaurant).

National Byproducts, Inc., which recently acquired Colorado Grease Company, appears to have the largest market share of the rendering companies serving the Denver-Boulder area. They pay some restaurants for grease, and do not pay some others (depending on volume and location). National has eight rendering plants in the mid-continent area, and provides bulk containers to its large customers (approximately 1.3 x 0.9 x 0.9 meters or 5 x 3 x 3 feet) which get emptied into the collection trucks, instead of exchanging 208-liter (55-gallon) drums as most of the rendering companies do.

Valley Proteins Inc. was typical of many rendering companies in that my calls were answered by secretaries who took messages, but the managers did not return the calls, even after several call-backs. Some rendering company managers said if I sent them a letter with my questions they would take a look at it, but that chances were good they would not respond with any quantitative information. I did not bother. Others were friendly and gave me qualitative information such as the names of the companies serving the metropolitan area and their approximate market shares, but stayed away from giving out data on quantities of grease collected. A few rendering company managers gave me their "estimates" of quantities of grease collected from restaurants in certain metropolitan areas. It was impossible to verify these estimates. In at least one case, I suspect the estimate provided by a rendering company manager was deliberately misleading (low).

The amount of yellow grease feedstock recovered per restaurant varies greatly for different types of restaurants. Jack-in-the-Box restaurants generate two or three times as much grease as McDonald's, whereas Denny's restaurants produce about 2/3 as much as McDonald's. A typical small family restaurant generates about 1/3 as much grease per day as a McDonald' s.

TRAP GREASE COLLECTED BY TANK TRUCKS

Most of the cities in the survey have a "grease traps" section in the yellow pages, which typically lists a small number of companies. Usually these companies are septic tank service companies that also provide grease trap service, usually with different trucks (depending on local regulations). If the yellow pages had no listings for grease traps, I was usually able to find several companies listed under septic tank service that also provided grease trap service. In some areas I found that rendering companies also pump out grease traps.

In general, attempts to develop estimates of the total amounts of grease trap wastes collected by tank trucks by asking the service companies themselves for the data were not successful. There were too many non-respondents or respondents who did not keep good records. After the first few metropolitan areas, my interview technique for these companies had evolved to a very short set of questions designed to find out where the grease trap pump trucks discharged the material and what the local regulations concerning such discharges were. If the answer was the local wastewater treatment plant, I would try to get information on quantities from the wastewater treatment plant, and usually met with success. If the answer was evasive, or honestly indicated that the material was being dumped somewhere, it was necessary to use a factored estimate.

Some cities and counties are grappling with the political issue of how best to handle grease trap wastes. Most wastewater treatment plant managers feel that from a technical point of view it is best to have strong regulations requiring restaurants to have grease traps pumped regularly, and to have the waste discharged at wastewater treatment plants where it can be properly treated and disposed of. However, local politics and lobbying by business owners often create much less effective approaches to the problem. In some areas, there are no legal or permitted approaches to disposing of grease trap wastes, forcing it to be done illegally. Data collection in such areas is essentially impossible.

Regulations in some areas (e.g., California) are moving, towards collection and processing of grease trap wastes by rendering companies instead of disposal in wastewater treatment plants. Newer restaurants in some areas of California are required to install interceptors instead of traditional grease traps. An interceptor is a larger device that can be visualized as a wide spot in the line that allows cleaner grease to be recovered.

In some cities, pump trucks drive to designated sites and discharge grease trap wastes to manholes that provide a "straight shot" to the wastewater treatment plant. In effect, restaurant grease is prevented from flowing through the narrow drains and piping at the beginning of the collection system, but is reinjected into the main sewage stream near the treatment plant where the lines are wide and plugging is not a concern. More commonly, trucks are required to discharge grease trap wastes at the wastewater treatment plant, where accurate records can be kept and sources can be monitored. Some plants have

pretreatment systems designed specifically for grease trap wastes. One pretreatment manager (in Altoona, Pennsylvania) places bacteria in several manholes to allow the pretreatment process to start before the sewage arrives at the plant.

Some wastewater treatment plants not only accept material pumped from restaurant grease traps; they accept food processing grease wastes as well. In Lincoln, Nebraska, one wastewater treatment plant receives not only all of the grease trap wastes collected in the metropolitan area, but also waste grease from an ADM soybean processing plant and a Cook Foods ham and bacon plant. In Memphis, one wastewater treatment plant receives effluent from a Protein Tech soybean processing plant and a Cargill corn processing plant.

Grease trap wastes in the Provo-Orem area are delivered to a soils regeneration operation in Salt Lake City, where oily wastes and greases are bioremediated using microbes and nutrients. Materials are blended and composted; the product is used as topsoil for the final cover on closed landfill sites. In the Boston area, grease trap pumping companies discharge pump trucks at processing facilities that charge tipping fees such as 2.9¢/liter (11 e/gallon) for grease trap waste and 1.6¢/liter (6¢/gallon) for septage. One major septic service company treats its own grease trap material, recovering the grease and landfilling the rest. In the Lakeland-Winter Haven and Bradenton, Florida metropolitan areas, several companies recover and process grease trap wastes. Nopec Corporation converts grease into biodiesel fuel, and septic tank service companies separate the waste grease from water, adjust the pH of the grease with lime, and land spread the material in accordance with permits from county and state environmental agencies. The Natural Solution Inc. in Shreveport uses a patented bioremediation process (bacteria) to convert grease to inert solids. Grease trap pump trucks in Bryan-College Station discharge at a wastewater treatment plant, where a private company processes the material with bacteria. The gray water enters the treatment plant and the solids go to a landfill.

In Harrisburg, Pennsylvania, a grease trap pumping company dewaters the material in a plate and frame filter press and hauls the grease cake to the Harrisburg Refuse Incinerator. Grease trap pumping companies in the Port Arthur, Texas area discharge their wastes at the Chemical Waste Management incinerator nearby, which receives hundreds of different types of wastes and chemicals, including PCBs and other hazardous wastes. The Beaumont, Texas wastewater treatment plant currently accepts grease trap discharges, but a plant is under construction by a private company that will convert the grease trap wastes to products. When this plant is operating, the Beaumont wastewater treatment plant will stop accepting grease trap discharges.

Data collected on grease trap wastes are subject to inherent inaccuracies because this material can include a significant amount of water and other materials mixed with the grease. In fact, the usable grease content may be as low as 5-10%.

RESTAURANT GREASE FLOWING TO WASTEWATER TREATMENT PLANTS

Grease traps are not 100% effective in capturing grease that goes down restaurant drains, and restaurant owners are not uniformly diligent (depending on local regulations and enforcement) in having grease traps serviced at regular intervals. In addition, households and other establishments discharge food wastes and grease to the sewer system. Motor oils and industrial oils are also included in the "oil and grease" component that makes its way into wastewater treatment plants. Some wastewater treatment plant laboratories report the oil and grease content of their influent wastewater in the units milligrams (mg)/liter; others report in parts per million (ppm). It turns out that these two sets of units are the same, because water weighs 1,000 grams/liter.

Although there is considerable variation, the amount of raw sewage entering wastewater treatment plants in the 30 metropolitan areas averages about 417 liters (110 gallons) per day per person. The range was from 136 liters (36 gallons)/day/person in the Harrisburg-Lebanon-Carlisle, Pennsylvania metropolitan area to 936 liters (247 gallons)/day/person in the Provo-Orem, Utah area. These values are the average flow rates reported by the plant managers; flow rates during rainstorms are much higher.

The concentrations of oil and grease measured in the raw sewage to wastewater treatment plants in the 30 metropolitan areas generally fall in the range of 20 to 50 ppm. The most detailed information I received on this subject was for a group of five plants in the Maryland suburbs of Washington, DC. Although individual (daily) measurements ranged from 1.2 to 206 ppm, the annual average concentrations for all five plants fell in the range of 27 to 38 ppm. It appeared from these data that 35 ppm was a good average value for the oil and grease concentration in the raw sewage in DC and its Maryland suburbs.

BIODIESEL PRODUCTION POTENTIAL

Of the three major components discussed above, the cleanest and therefore "easiest" to convert to biodiesel fuel is the yellow grease feedstock. However, this material has a market value close to 44¢/kilogram (20¢/pound), or about 37¢/liter ($1.40/gallon). Add the conversion costs, and the resulting biodiesel fuel would be very expensive compared to conventional diesel. The second and third components, grease trap waste that is either collected by pump trucks or received in raw sewage at wastewater treatment plants, are contaminated but have the advantage of being approximately "free." At least one company in the US (Nopec in Lakeland, Florida) is converting grease trap waste into biodiesel, but this study did not attempt to learn the technical or economic details of that process.