Fats, Oil, and Grease Management Alternatives February 15th & 16th, 2005

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SPEAKER

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A Land Treatment Approach to Grease Trap Waste Management

Background Information

- Fatty wastes are by-products of food processing at the industrial, commercial and domestic level.
- On the eastern seaboard, the number of food establishments is growing at a rate of ~5% per year.
- Greater demand for prepared foods by a growing population results in the production of greater amounts of fatty waste
- From a mechanical and biological standpoint, fat, oil and grease (FOG) is problematic in both solid and liquid waste streams.

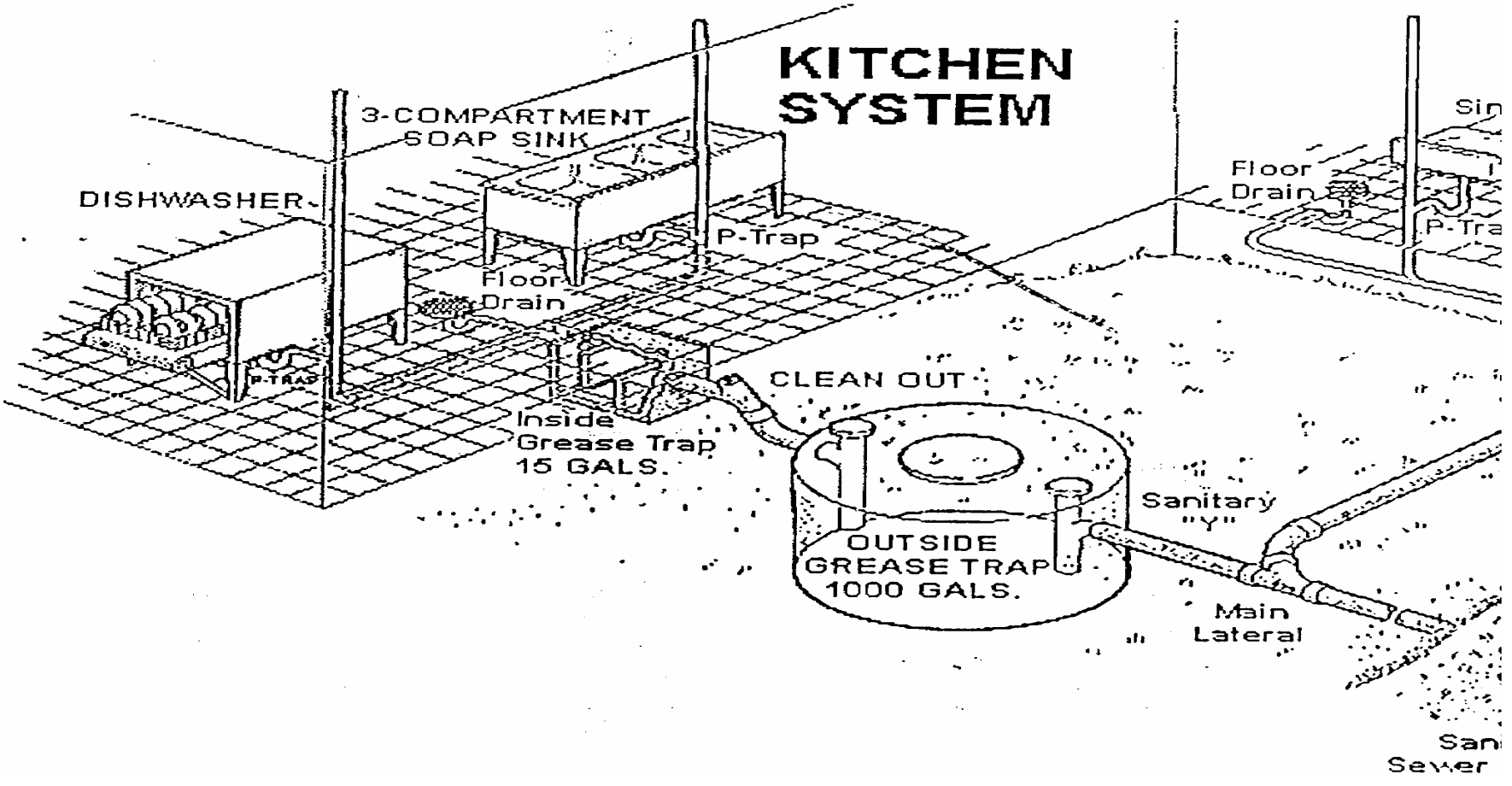
What is FOG?

- FOG is the acronym for the wastewater borne fat, oil and grease waste from industrial, commercial and domestic food preparation.
- FOG, concentrated in a “grease trap” or “grease interceptor,” is usually referred to as grease trap waste (GTW).
- In the rendering industry GTW is called “brown grease”.
- Regardless of the name, this waste by-product is chemically classified as “fat”.

What is Fat?

- Food fat and oil are chemical units commonly called “triglycerides” resulting from the combination of one unit of glycerol with three units of fatty acids.
- Fats are simple organic compounds consisting of carbon (C), Hydrogen (H) and Oxygen (O).
- At normal room temperatures fats range in consistency from liquids to solids.
  - When solid they are referred to as “fats”
  - When liquid they are called “oils”.

What is a Grease Trap?



What's in a Grease Trap?

- Grease
  - Animal and vegetable oils- chemically classed as fats
- Water
  - Dissolved and colloidal solids
- Sediment
  - Other wasted food particles
  - Sludge – partially digested organic material
- Refuse
  - Plastic, paper, pot scrubbers, and whatever can fit down the drain

GTW Analysis (example)

Parameters	Concentration	Units
BOD_5	> 22,260	mg/L
% Solids	39.7	%
pH	4.2	S.U.
TSS	47,120	mg/L
TVS	388,857	mg/L
*Fecal Coliform	>240,000	MPN/gm
FOG (avg.)	579,333	mg/L

** Consider GTW as a class B biosolid with regard to pathogens*

Nutrient Analysis (Example)

Parameters	Concentration	Units
TKN	56	mg/L
Ammonia	10	mg/L
Organic N	46	mg/L
Nitrate N	non-detect	--
Total P	29	mg/L

- Total N per ton (dry wt.) = ~ 9.3 lbs
- Total P per ton (dry wt.) = ~ 4.8 lbs

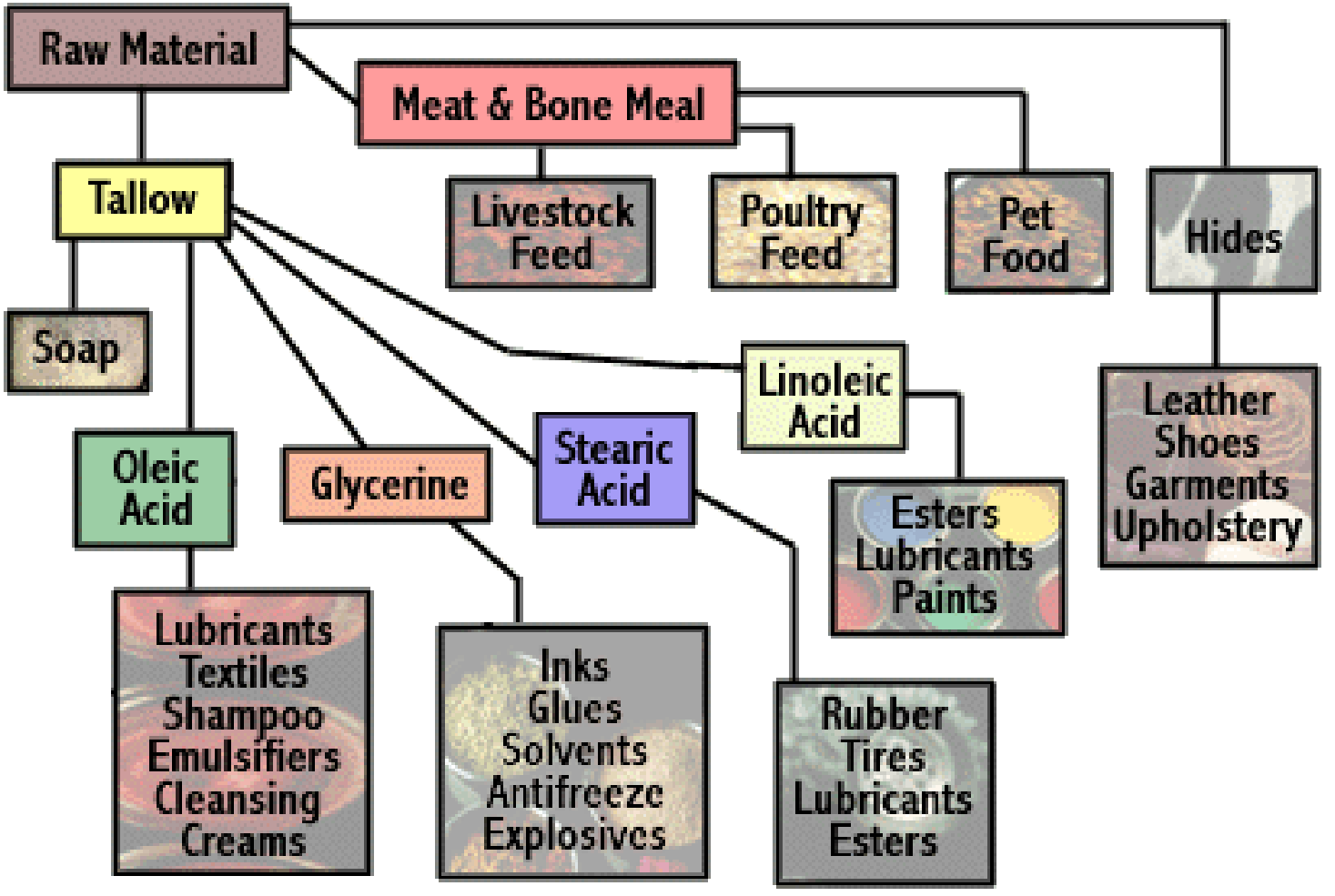
GTW Disposal Options

- **Landfilled** - after dewatering or mixed with other, dry waste, to attain 20% solids content to allow transportation and dumping.
- Minor modifications to aerobic and anaerobic digesters make them suitable to digest GTW. (The latter allows for methane recovery.)

GTW Beneficial Reuse Options

- Used in rendering industry (lubricants, industrial soaps)
- Used in compost recipes
- Used as an energy cogeneration fuel (after drying)
- Used as a soil conditioner (That’s what we’re here to talk about today)
- Small amounts used in biodiesel production

Quick Overview of Rendering



GTW Handling Issues

- Primarily an urban/suburban issue
  - Large numbers of food preparers
  - GTW must transported great distances if not accepted at local WWTP
- Population increasing and encroaching into surrounding rural area
- Loss of Renderers to distant rural areas due to odor problems
- Not all jurisdictions allow land treatment on agricultural land
- In areas lacking a suitable disposal option, the waste hauler and generator placed in a potentially criminal situation

Land Treatment Approach To GTW Management

- Soil microbes, particularly, bacteria and fungi, utilize (decompose) the FOG and other waste as food.
- The microbial population dies-off after the food supply is exhausted – GTW IS BIODEGRADED.
- Applied agronomically, GTW can improve soil texture and organic content – DECEASED MICROBES BECOME HUMUS.
- Over application of GTW can cause undesirable odors as a result of anaerobic conditions in the soil and the above scheme is upset – ODORS, FERTILITY, SOIL pH & CROP GROWTH is adversely affected.

How GTW Regulated?

- GREASE TRAP WASTE IS **NOT** REGULATED BY 40 CFR PART 503
- At the federal level 40 CFR Part 257 (A) regulates “Land Treatment” sites
- In Delaware, Part V of the *Regulations Governing the Land Treatment of Wastes* regulates agricultural use of waste products
- Several other States permit land treatment of GTW as either a separate material or mixed with septage/biosolids

Is GTW Analysis Required?

- At the federal level, testing is prescribed in 40 CFR Part 257 (A).
- Also at the Federal level, testing under 40 CFR Part 261 is required if GTW is possibly “hazardous waste”.
- At the state level, testing may be prescribed by regulation or permit.
- State Nutrient Management Regulations may require additional analysis and record keeping.

Additional Analysis

- GTW
  - Total Volatile Solids
  - Fecal Coliform
  - pH
- Site Soil Analysis
  - Full agricultural soil test including total organic material
    - N, P, K, Ca, Mg, S and micronutrients

Monitoring and Record Keeping

- All State agencies with land treatment oversight programs will require monitoring and record keeping to satisfy regulatory requirements.
- GTW application rates must be recorded.
- Land management is a key factor in maintaining a successful land treatment site so site information should be recorded (weather, soil conditions, etc.)
- Crop and nutrient management records should be maintained and reviewed to assure that there is a benefit of employing the land treatment practice and to satisfy Nutrient Management Regs.

How Does GTW Work in an Agricultural System?

- GTW can be applied onto and into moderately to well drained soils at upwards of 8 Tons per acre as Total Volatile Solids.
- Incorporation of GTW reduces odor and creates greater surface area for microbes to feed upon.
- Crops should not be planted for several days to two weeks due to Nitrogen demand by the extremely active microorganisms
- Soil microorganisms will degrade the GTW rapidly if **soil conditions are favorable**

What are Favorable Soil Conditions?

- Favorable soil conditions are:
  - Warmth
  - Moisture
  - Oxygen
  - Nutrient availability, especially Nitrogen
- Conventional tillage and fertilization provide oxygen and the nutrient
- Mother nature provides the warmth
- GTW provides initial moisture upon application

What Agricultural Benefits Can Be Expected?

- Increased organic content of a soil
- Increased soil moisture retention due to increased organic material
- Decreased leaching of Nitrogen due to the slower release of N from an organic form (organics increase CEC)
- Improved soil structure due to increased organic material from microorganism decay (i.e. cellular material binds silt and other fines together)

Sawyer Sanitation
Land Treatment Site



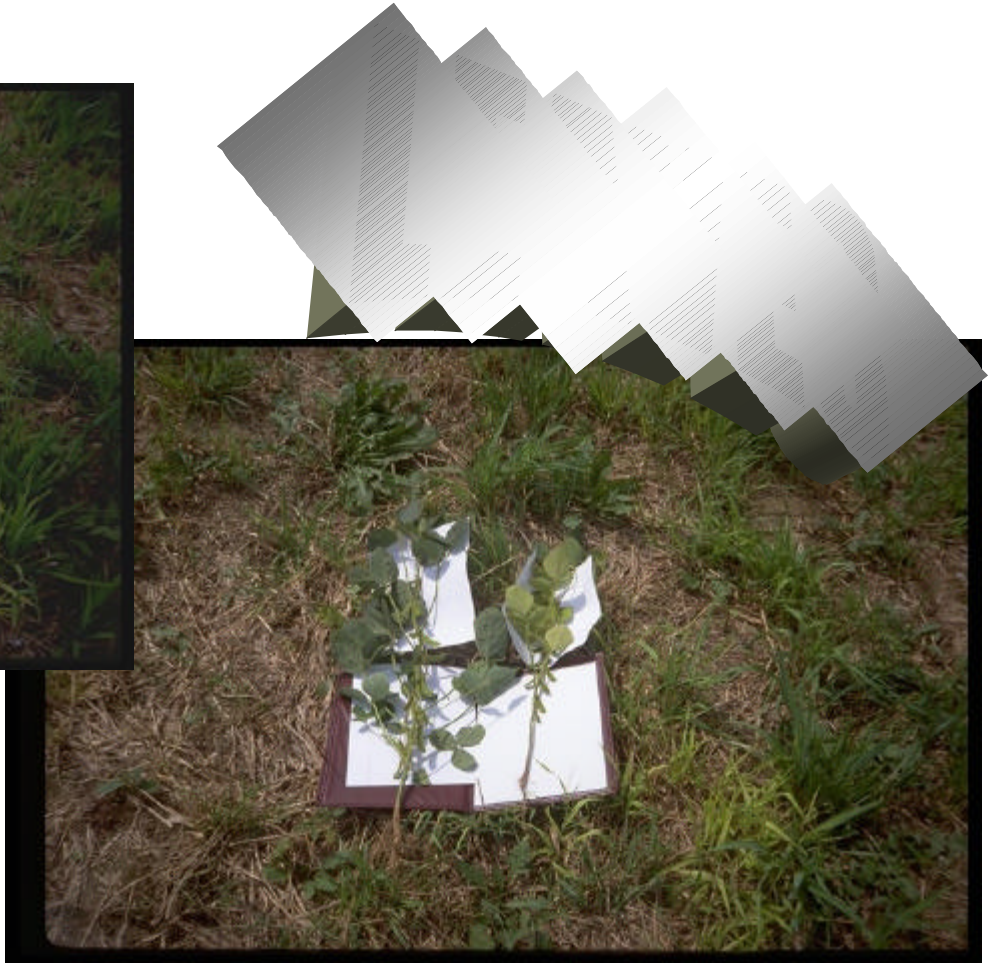



One Approach to Land Application

ISDELL PUMPING AND SANITATION

The preferred method of land application

Improved Soil from several GTW applications = Healthier plants



Epilogue

- GTW isn’t always a waste.
- Conventional farming practices provides an avenue for the land treatment of GTW.
- Land applied GTW provide measurable improvements in soil texture and organic content Regulations allow for the land treatment in many jurisdictions IF you want to pursue it.
- There are other methods for the recycling of GTW IF you are willing to search for them.

Some Convincing Photos

Untreated areas

GTW Application Area

QUESTIONS

For Additional Information

Darling International Renders - www.darlingii.com

In-Vessel Composting of Grease Trap Waste and Biosolids http://www.tamu-commerce.edu/coas/agscience/res-dlc/grease/coffield-g.html

Characterization of the Generation, Handling and Treatment of Spent Fat, Oil, and Grease (FOG) from Georgia's Food Service Industry

http://www.engr.uga.edu/service/outreach/FOG%20Report%20Final.pdf

References:

[1] Livernais-Saettel, L., http://www.dietobio.com/dossiers/en/fatty_acids/molecule.html

[2] Beavon, Rod, "Rods Pages – Esters, Fats and Oils" http://www.rod.beavon.clara.net/efo.htm#Fats

[3] Author Unknown, "Table 39--Fats and oils used in edible products, by use, U.S., 1994/95 to date, Table 39--Fats and oils used in edible products, by use, U.S., 1994/95 to date 1/2002", USDA Economic Research Service, http://usda.mannlib.cornell.edu/data-sets/crops/89002/table39.xls

[4] Campbell, Ed, et al (the Technical Committee of the Institute of Shortening and Edible Oils, Inc.), "Food Fats and Oils", Institute of Shortening and Edible Oils, 1750 New York Avenue NW, Suite 120, Washington, DC 20006, http://www.iseo.org/ffo_preface.htm

[5] Kiepper, Brian, et al, "Characterization of the Generation, Handling and Treatment of Spent Fat, Oil, and Grease (FOG) from Georgia's Food Service Industry", College of Agricultural & Environmental Sciences, Department of Biological & Agricultural Engineering, Engineering Outreach Program, University of Georgia, (February 2001).

[6] National Restaurant Association, 1200 17th St., NW, Washington, DC 20036 (http://www.restaurant.org/research/state_stats.cfm)

[7] Author Unknown,"Environmental Perspective",National Renderers Association http://www.renderers.org/Environment/index.htm

[8] "Lipids", http://www.cem.msu.edu/~reusch/VirtualText/lipids.htm#fats

[9] Author Unknown, "Rendering and meat byproduct processing: Industry Statistics Sampler: AICS 311613" *http://www.census.gov/epcd/naics02/def/ND311613.HTM*

[10] Neal, D. M., Glover, R. L., Moe, P. G., “Land Disposal of Oily Wastewater by Means of Spray Irrigation”, Chapter 41, *Land as a Waste Management Alternative*, Lower, R. C. (editor), Ann Arbor Science Publishers, 1977.
11 Overcash, M. R., Pal, D., “Design of Land Treatment Systems for Industrial Wastes - Theory and Practice”, Ann Arbor Science Publishers, 1979
12 Reed, S. C., & Crites, R. W., “Handbook of Land Treatment Systems for Industrial and Municipal Wastes”, Noyes Publications, 1984.
13 USEPA Publication, (EPA/625/R-94/002), “Guide to Septage Treatment and Disposal”, 1994
14 Carr, L. E., Moore, R. C., Merka, W. C., Schales, F. D., “Land Disposal of Dissolved Air Flotation Sludge from Poultry Processing”, Transactions of the ASAE (Vol. 31, #2, pp. 462-465) 1988.
15 Ritter, W. F., “Land Disposal of Poultry Processing Sludge”, Agricultural Engineering Dept., University of DE, Final Report, 1982.
16 Van Opstal, B., Voroney, R. P., Carruthers, D., “Use of Fat Oil and Grease Waste as an Agricultural Soil Conditioner”, Proceedings of the 12th Annual Residuals and Biosolids Management Conference, Water Environment Federation, July, 1998.
17 Plante, A. F.., Voroney, R. P., “Decomposition of Land Applied Oily Food Waste and Associated Changes in Soil Aggregate Stability”, Journal of Environmental Quality, Volume 7, no. 2, March-April 1998.
18 Author Unknown, “Trash to Treasure - NREL’s High-Solids Digester Converts Wastes to Biogas and Compost”, National Renewable Energy Laboratory, NREL/MK-336-5683, April 1994

19 Author Unknown, “Aerobic Digester”, Carbofil.com, France
http://www.carbofil.com/gb-index.htm
20 Rohm, S.P., “Land Treatment of Grease Trap Wastes - A Beneficial Use Approach”, Pumper,
March 2000.
21 Author Unknown, “Anaerobic Lagoons”, the United States Environmental Protection Agency, Office of Water, Wastewater Technology Fact Sheet, EPA-832-F-02-009, (Sept. 2002)
22 Kinast, J. A., “Production of Biodiesels from Multiple Feed Stocks and Properties of Biodiesels and Biodiesel/Diesel Blends”, Final Report - Report 1 in a series of 6, Gas Technology Institute Des Plaines, Illinois, (Under contract to: National Renewable Energy Laboratory)
23 Author Unknown, US Census Bureau, M311K series for Fat and Oils: Production, Consumption and Stock, Source:
http://www.renderers.org/Statistics/Prodn-consum-exp%20of%20RP%2098-03.pdf
24 Author Unknown, “Fats, and Oils: Production, Consumption and Stocks: 2002”, Summary, M311K(02)-13, July 2003,
http://www.census.gov/cir/www/311/m311k.html
25Author Unknown, “IIASA Population Projection Results”
http://www.iiasa.ac.at/Research/POP/docs/Population_Projections_Results.html#Contents