

**Milkhouse Wastewater
Characteristics on
Wisconsin Dairy Farms**

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Introduction:

This report describes milkhouse wastewater characteristics on five Brown County Dairy Farms. The **pre-implementation** data was used to determine what types of treatment systems would be viable and cost effective. The intent of this study is to characterize pollutants found in milkhouse wastewater so that the efficiency of a constructed wetland for treatment can be more clearly evaluated.

Since little was known about milkhouse wastewater characteristics on Wisconsin dairy farms, pre-implementation monitoring was necessary to determine contaminant levels and help finalize details in the milkhouse wetland design. With the pre-implementation data, the Engineering Team was able to better understand system failures, improve wetland treatment system effectiveness, longevity of treatment and disposal of milkhouse wastes.

The disposal system **designed** for this demonstration project is a wetland filter system. The wetland filter system was designed by a University of Wisconsin Madison Department of Agriculture Engineering Team and the staff from the Soil Conservation Service.

There are several conventional systems that handle milkhouse wastewater. The most common system consists of a drain from the milkhouse to a surface area away from livestock holding areas. Septic systems are another method for handling milkhouse wastes. Due to the composition of milkhouse waste, septic systems usually fail. Continuous flows of large amounts of wastewater results in solids buildup which causes plugging and contributes to treatment system failures. Upon failure milkhouse wastewater may directly discharge into surface waters or may create marshy areas which produce odors and provide prime habitat for disease and unwanted insects. Another problem with failing treatment systems is the possibility of groundwater contamination.

Milkhouse wastewater can cause tremendous surface water deterioration when not properly treated and disposed. Milkhouse wastes contain not only waste milk but a variety of other wastes. These include: manure, bedding (straw), cleaning and disinfection agents, urine, and hoof dirt. These wastes contribute to high levels of phosphorus, BOD (Biochemical Oxygen Demand), organic solids, ammonia nitrogen, and chlorides along with low pH **and** dissolved oxygen values in surface waters.

Organic solids are broken down by bacteria in a process which requires oxygen. When these solids are discharged to surface water, oxygen depletion occurs. The bacterial breakdown of 1 pint of milk requires the amount of oxygen dissolved in about 1600 gallons of water (Graves, 1986). Oxygen depletion and the presence of ammonia disrupts fish **and** aquatic communities and can lead to fish kills. Phosphorus from detergents and other cleaning agents contribute to the increased growth of algae and aquatic plants. Decomposition of aquatic plants also removes oxygen from the water column.

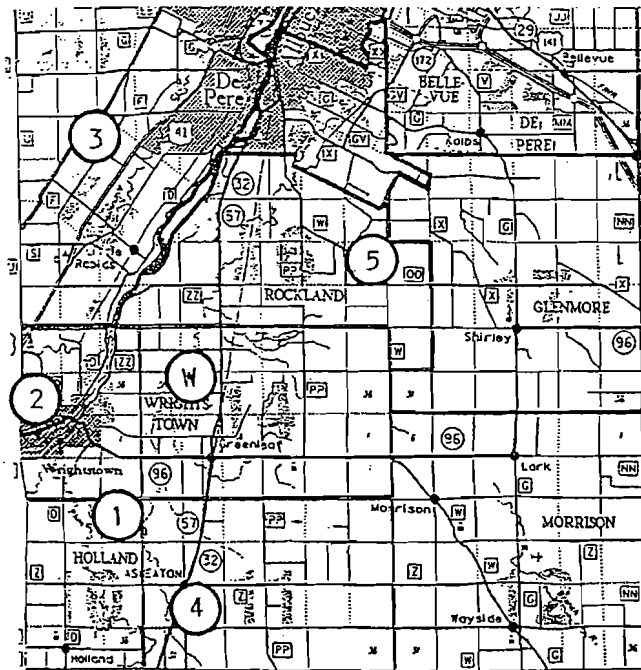
Objectives for the Milkhouse Waste I Project:

- *Design and construct a milkhouse waste disposal system.
- *Increase the use of milkhouse waste disposal systems which reduce surface and groundwater pollution risks.
- *Reducing the volume of wastewater and contaminants through source control measures.

Methods & Materials:

Water chemistries were collected from five dairy farms located in Brown County (see Figure 1 for sample site locations). Composite samples were collected from total milking center waste produced from two consecutive milkings. The waste was stored in plastic storage tanks with capacities ranging from 300-550 gallons. This waste was then transferred to the manure pit where it was mixed and landspread. This milkhouse waste does not enter surface waters, unlike other dairy farms in the area that do not have treatment systems and discharge to ditches or other areas away from the farmstead. Samples were collected during the following seasons; winter, summer and fall of 1992. Samples were collected three times in winter, two times in summer, and two times in fall. This type of sampling was used to determine the quality, strength, composition, and seasonal variability of milkhouse waste.

Figure 1. Milkhouse waste sampling sites



To determine what affect bulk tank waste has on the final waste' product, samples were collected two times (with and without the bulk tank waste).

Residual milk from the pipeline was removed and analyzed to determine contaminant levels of which are contributed to the overall waste produced. A sample was collected from Dave **Gerrits'** Farm (a volunteer for the constructed wetland). See Figure 1 for wetland site location.

Lab Form 4800-3 was used and quality assurance/quality control procedures were followed.

Samples were analyzed for the following parameters: BOD,, pH, chemical oxygen demand, total solids, suspended solids, volatile suspended solids, fecal coliform, chloride, total Kjeldahl nitrogen, ammonia nitrogen, nitrate plus nitrite nitrogen, total phosphorus and dissolved phosphorus.

Along with analyzing milkhouse wastewater, each of the 5 farmers were given a Farm Milkhouse Waste Inventory Questionnaire. This three page survey helped the Engineering Team to get a better understanding of the dairy milking procedures on each farm and to determine why there may be variability in the pre-implementation data.

Results & Discussion:

Milkhouse wastewater characteristics observed at five Brown County dairy farms is quite variable. Depending on farm size, type of equipment used and most importantly daily management practices, the concentrations of contaminants and water usage varies from farm to farm. The data indicates the need for much concern to implement new and lasting treatment systems which are able to accommodate milking center wastes.

Water Usage: Water meters were installed at five of the farms monitored. Milkhouse wastewater produced from the milking centers ranged between 230-550 gallons per day. Daily average water use per cow ranged from 2.95-5.53 gallons.

Types and levels of contaminants found: High levels of BOD,, chlorides, ammonia, total solids, COD, total and dissolved phosphorus, total and suspended solids, and total **Kjeldahl** Nitrogen were found in all samples collected. From the data gathered, it is evident that milkhouse wastewater contains levels of contaminants that **could** be toxic to fish and aquatic communities if discharged to surface waters. Samples were collected in winter, summer, and fall. Values below are averaged from three seasons. Table 1 below summarizes wastewater characteristics observed at the five farms monitored. Figures 2, 3, and 4 show seasonal variability of BOD,, total phosphorus, and total solids. These contaminants cause conventional systems to fail, and are deleterious to surface waters if not properly treated.

Table 1.

Milkhouse Wastewater Characteristics from Five Brown County Dairy Farms 1992												
Farm site #	BOD, mg/l	Ammonia Nitrogen mg/l	Total Phos. mg/l	Dis. Phos. mg/l	COD mg/l	Chlorides mg/l	Total Kjeld. N mg/l	Total Solids mg/l	Sus. Solids mg/l	Herd Size	Average H ₂ O Use gallons /day	Daily Aver H ₂ O Use gallons /cow
1	3467	1.328	77.15	67.9	5611	569	98	4872	1705	85	400	4.41
2*	295	0.138	58.1	51.3	616	100	26	1721	73	105	303	2.89
3	1157	1.365	39.96	33.53	1756	845	53	3035	549	85	323	3.80
4	1092	4.39	25.75	25.71	1227	703	39	2917	307	54	252	4.67
5	1789	0.793	112.9	87.71	2300	319	55	2941	636	145	473	3.26

* = Farm 2 does not include bulk tank waste in overall waste produced.

An example of equipment and management practice influencing the contaminant levels is farm #2. This particular farmer does not include his bulk tank waste with the overall wastewater produced. All levels reported for this farm are considerably lower than the others sampled. From the data presented it is obvious that bulk tank waste contributes to these high overall values.

Figure 2

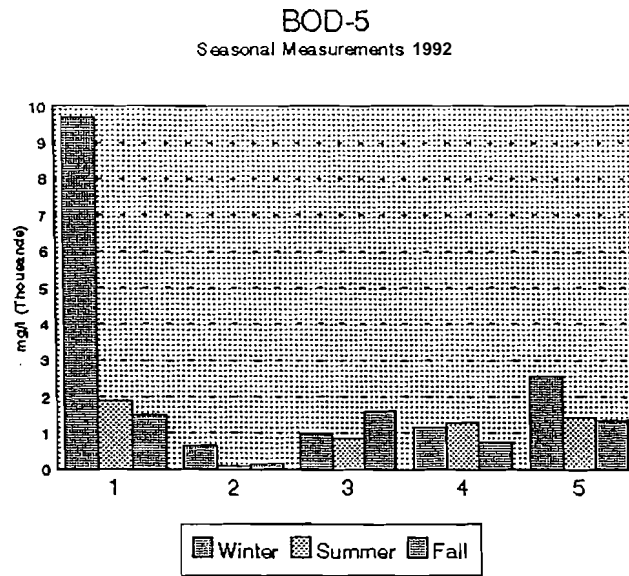


Figure 3

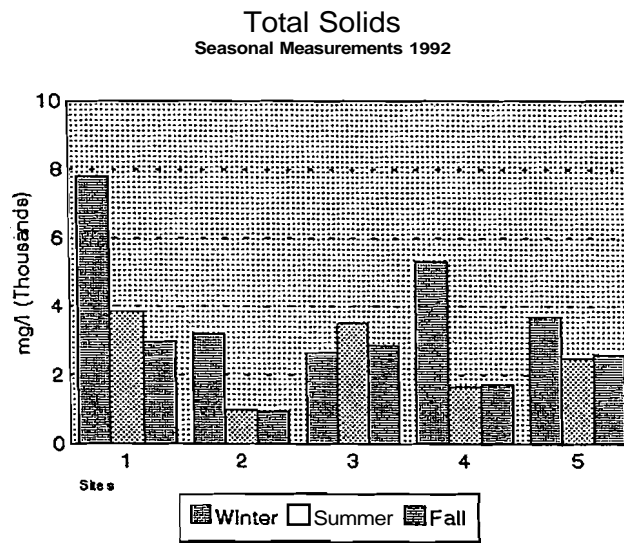
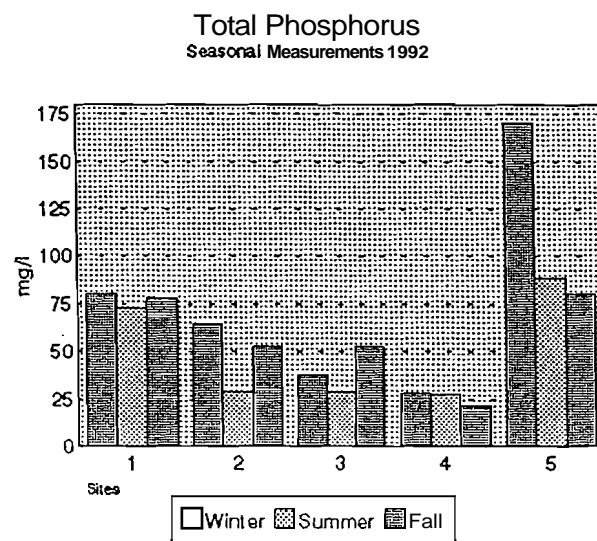


Figure 4



Waste milk: Waste milk is the residual milk left in the pipeline after the milking process has finished. This milk never reaches the bulk tank and is flushed to the disposal system during the rinse cycle. Approximately 1-10 gallons of residual milk remains in the pipelines after milking processes are complete. The volume is dependent upon pipeline structure and equipment efficiency (Payer, 1993). Samples were collected from three gallons of residual milk and analyzed to determine contaminant concentrations. Waste milk is the largest contributor to the high levels of contaminants reported in the overall wastewater produced. Table 2 reveals that waste milk contains extremely high concentrations of all parameters which were analyzed, as compared to the combined wastewater generated from the cleaning and sanitizing cycles. The volume of water used for cleaning and sanitizing the pipeline, ranges between 60-165 gallons per milking.

Removing the residual milk and feeding it to hogs or calves or land spreading it rather than disposal by conventional methods will reduce the risk of treatment system failure. Through these source control methods farmers can reduce the volume of residual milk that is combined with the final wastewater. Reducing the amount of residual milk in the wastewater greatly reduces final pollution concentrations. Source control for milking center wastewater management has been developed to help dairy farmers operate in a more profitable and ecologically sound manner. Source control consists of a series of procedures designed to decrease the amount of pollutants and water leaving the milking center while maintaining milk quality (Payer, 1993).

Table 2.

Waste Milk Concentrations vs. Wastewater from Remaining Cleaning Processes - Dave Gerrits Farm 1992										
Station ID	BOD, mg/l	COD mg/l	Ammonia Nitrogen mg/l	Nitrate + Nitrite Nitrogen	Tot. Kjeld. Nitrogen mg/l	Total Phos. mg/l	Dis. Phos. mg/l	Total Solids mg/l	Sus. Solids mg/l	Vol. Sus. Solids mg/l
Residual Milk from pipeline	>720	14,000	0.403	1.05	280	52.5	28.4	9840	4820	4720
Remaining Wastewater	<6	110	0.010	.72	1.4	2.48	0.36	1300	14	12

Conclusions:

The data clearly shows the need for viable and cost effective disposal treatment systems for milkhouse waste. Since milkhouse waste contains a whole host of contaminants which can affect surface and groundwater, it is imperative that dairy farmers be informed and educated about source control and proper disposal methods. This will allow them to manage and reduce milkhouse waste in a ecologically sound manner, while maintaining the quality of milk.

This study will be followed by a constructed wetland which will serve as a disposal treatment system for milkhouse waste. The wetland located near Greenleaf is currently in full operation. Monitoring has begun and will continue through 1994. Monitoring will determine if the wetland is a viable and cost effective means of treating milkhouse waste.

References

- Graves, Robert E. Milking Center Wastewater Disposal. 1986. Pennsylvania Department of Environmental Resources.
- Payer, David. Milking Center Wastewater and Source Control-bulletins draft. 1993. Outreach University of Wisconsin Madison, Agricultural Engineering Department.