MEASURES TAKEN AGAINST WATER POLLUTION IN DAIRIES AND MILK PROCESSING INDUSTRIES

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ABSTRACT

Dairy waste, more than any other trade waste has long since attracted the attention of specialists in the field of waste water purification. Many experiments have been made with artificial waste water, made from milk or milk products. Dairy wastes provide an excellent nutrient medium for many types of bacteria and fungi and, contrary to opinions held at one time, are very amenable to aerobic biological treatment.

The rapid oxygen consumption of dairy waste is, on the other hand, a disadvantage. Discharge into public water will lead to lack of oxygen, much quicker than in the case of domestic sewage. Anaerobic conditions can be observed in small streams at a short distance from the point of discharge.

Dairies discharging effluent into local sewers must generally comply with requirements as to volume and strength of the waste in order to safeguard the purification plant.

The need for purification of domestic sewage and trade wastes is obvious in almost every country in the world. The efforts made to reach or safeguard a healthy milieu are, generally speaking, very expensive. Sometimes they hardly seem economical. It is therefore of the utmost importance for industry to reduce the pollution load to the bare minimum, thus lowering the purification costs.

Many countries now have their laws which enable the government or local authorities to require purification up to certain standards. This may be done in plants built and run by the individual factory, in those cases where discharge into a public sewage works is impossible e.g. through distance between factory and works and the absence of a sewerage system. In an increasing number of cases however, private purification will be more economical. The tax tariffs rise due to higher purification standards required and to growing investments and labour costs.

The industry can derive profit from low energy prices for their plants, by using existing laboratory and technical workshop facilities and from certain tax facilities in the capital costs. These and the fact that dairy waste is non-pathogenic and non-toxic can explain that all over the world dairy waste treatment plants can be found ranging from simple sedimentation plants up to advanced waste treatment systems, eventually with re-use of effluent.

The methods generally used for aerobic biological treatment are filtration and activated sludge.Filtration only gives a reliable performance in the modification of alternating double filtration, popular especially in the United Kingdom. Filtration by means of plastic media can be used as a roughening treatment prior to full biological treatment. The conventional activated sludge system may produce an acceptable effluent but needs considerable care in maintaining a good quality sludge. The extended aeration process,

with a very low loading per unit of aeration tank, proved to be reliable, uncomplicated and cheap, constantly producing a high quality effluent and relatively small quantities of surplus sludge. Under very special circumstances lagooning and spray irrigation can offer an acceptable method for handling dairy waste water.

INTERNAL MEASURES

1. Volume reduction

This applies only in cases of free discharge into surface water, the volume of the waste water flow being of no interest except for the design of the sewerage system of the factory. In every other case, purification in a private or public plant or discharge into a public sewer, the maximum hourly flow as well as the total daily volume are important. At least two factors do influence the actual cost of purification. One of these is the volume, especially the maximum flow per hour. The other factor is the quantity of pollution, mostly expressed as kg oxidizable matter per day. Generally costs will be reduced by minimizing the flow.

There are of course several possibilities for reducing the amount of water used, or hardly used, in a dairy. In every situation there will be an economic limit. There is no sense in investing beyond that point. If there is an unlimited and cheap supply of water, suitable for cooling purposes and for cleaning, the only measure that pays will be to discharge the non-polluted cooling water by a separate sewerage system, direct into surface waters.

If supply is limited or the water price is high, due for example to a complicated conditioning procedure, it usually pays to reduce the volume by re-use of cooling water. This also holds true whenever discharge of the total cooling and waste water is only possible into a public sewer combined with a public sewage works. This situation is found by dairies in town centres or in districts with hardly any surface water.

Provisions for re-use are storage tanks or cellars with a separate distribution system. The ultimate use will be for cleaning purposes, constituting the polluted water flow. As this amount in a modern dairy is about 1.5 to 3 times the quantity of milk handled, there will nearly always remain a certain surplus of cooling water to be disposed of. This can be concluded from *Table 1*, based upon data from Dutch dairies, gathered by Rijks Agrarische Afvalwater Dienst, Arnhem (R.A.A.D.).

Table 1. Water consumption in dairies (litres water/kg milk processed)

Type	Average	Highest three			Lowest three		
Butter and cheese	10.7	31.2	17.7	15.1	3.0	3.0	5.8
Bottling	17.3	35.0	34.8	34.0	7.5	8.0	9.0
Powder and condensed	11						
Butter	8.7	17.1	13.8	13.1	3.7	4.2	5.7

With cooling towers a highly effective reduction of cooling water can be achieved. These might be the size of the big concrete structures well known from power works. But the modern types with plastic medium are as effective and more adapted for dairies.

Cooling by means of an evaporation condensor theoretically only requires replacement of the water evaporated. Quite the contrary of this advantage is an increase in energy consumption of the unit, due to an elevated condensation temperature.

It is obvious that besides the necessity to use modern, effective equipment for cooling purposes in general, devices must be available for a correct measuring of the flow in the apparatus. Without knowing reliable figures it will be impossible to make economical calculations about alternatives. Since this paper is concerned with general possibilities in this field rather than detailed information, I shall now discuss internal measures for reducing pollution.

2. Pollution reduction

The milk-processing industry has the advantage over other sectors of industry, that the raw material handled is rather expensive. It is necessary therefore to give attention to reduction of losses. Besides that milk and its by-products do have a high pollution strength, as *Table 2* illustrates, which makes it more profitable to cut unnecessary losses to a minimum.

Table 2. Comparison of the BOD of milk and milk by-products with that of domestic sewage

Product	BOD in mg/l
Milk	110,000
Skimmed milk	72,000
Buttermilk	70,000
Whey	40,000
Cheesepress whey	20,000
Domestic sewage	540

A large number of publications exists giving general or detailed information on how to reduce losses in dairies[1,2]. National dairy organisations and research institutes have been alert in this field. Many dairy handbooks nowadays pay attention to this problem. Constructors of equipment as well as architects are aware of the needs in this respect.

It cannot be the aim of this paper to detail all the existing information. Generally speaking it can be stated that loss by spillage (leakage and drippage) must be prevented simply by 'good housekeeping'. Milk- and whey-powder losses must be collected dry before washing down. Prior to rinsing of pipelines, apparatus and tanks, the content of product must be carefully drained off, followed by a first rinsing with a small volume of water. The concentrated material thus collected is often worth drying or evaporating. Churns must be given the time to drain completely before being cleaned. Prerinse of churns with a small amount of hot water recovers many litres of milk and many kg BOD per day.

Processing losses can be prevented mainly by the use of up to date apparatus. Modern evaporators and continuous butter machines produce only minimal pollution. Besides that there are in butter production several processes reducing the volume of butter washings as well as their strength.

Cheesepress whey should be hygienically collected and processed with the bulk of the whey. If discharged into the sewer, the press whey contributes to the pollution of a cheesemaking dairy, depending upon type of cheese, for about one third of the total load. Bottling apparatus must have provisions for collecting the content of broken bottles.

Byproducts, having a low economic value but, according to *Table 2*, a high pollution strength, are often handled without care. Losses of skimmed milk and especially of whey can be extremely high. These might be due to structural problems. There are indeed many countries or regions in countries with insufficient facilities for utilisation of these byproducts. If the only outlet is the use as pig feeding in liquid form, a large percentage of the production will land in the sewer. Modern farming is based upon high efficiency in feedstuff as well as in automation of the feeding procedure. Whey does not fit into this. Besides that there is always an uncertainty of supply.

The only reliable way for productive disposal of the byproducts is to concentrate and dry them. In such a form they can be made up into valuable food for humans and animals. It can also be the raw material for milk sugar production or for the production of a non-alcoholic long drink as is done in Holland. Another suggested method of utilisation is as a medium for growing yeast. All these methods however ask for a considerable expenditure on plant. Here arises the structural problem, because smaller dairies cannot afford this. The solution might be that large factories cooperate in this with the small ones, to run an economic-sized plant for utilising byproducts. The irregular seasonal supply makes it impracticable to found central plants of small capacity.

As long as the problem of discharge of whey is not solved in the way just described, it will be impossible to run a purification plant without having constant trouble. There is no hope for a good design of such a plant if an irregular discharge of whey must be expected. And if the discharge is regular no director can pay the money that the over-seized plant must cost. If the available capacity is insufficient during short seasonal peak periods in supply, discharge to sea or to a surface water of large self-purifying capacity is possible. This only can be done with due regard for restrictions imposed by the authorities. Also spray irrigation of limited seasonal surpluses can be a practicable solution. In emergencies whey may be disposed of by tankers on to grassland.

It will be clear that management and staff must be interested in the factory's effluent production. The only way to achieve better results in this field is to sample frequently and to publish the results to the staff and to the workers. The low pollution figures attained will minimize the costs for purification. In Holland there are already some industries which pay part of the profit, so derived, as a bonus to the employees concerned. In fact this is the ideal basis for stabilization of pollution load at the lowest possible level.

DETERMINATION OF POLLUTION LOAD

It is obvious that with rising costs for discharge of waste, the amount of pollution must be known as exactly as possible. This holds in case of paying a pollution tax to an authority as well as in designing and running a private purification plant. The basic figure for all this can not be an estimate or a guess.

Without giving detailed information about all the existing systems based upon rateable value of properties, volume, production etc., it may be stated that there are three ruling factors:

1. Volume, especially maximum flow per hour.
2. Quantity of organic matter (kg BOD_5 per day).
3. Quantity of suspended solids (kg per day).

These three factors do influence the actual cost of purification. In order to calculate the exact rates, the discharge of trade waste must be controlled. Data about volume can be obtained by means of flow-meters or recorders. Sampling is inevitable in controlling the two remaining factors.

By a very even flow during the whole of the daily production period, a reliable sample can be obtained by withdrawing a small constant part of the total flow, e.g. by means of a peristaltic pump or bucket-elevator. In many industries however, the daily flow varies constantly and in order to obtain a dependable sample, frequent and proportional sampling is necessary. The Government Agricultural Waste Water Institute (R.A.A.D. at Arnhem), having the task of advising agricultural industries on problems concerning the discharge of trade wastes, consequently developed some years ago the 'Fleebalt' apparatus, thus named after its inventors. This proportional sampler, used in combination with a measuring weir (preferably a V-notch, although other types of weirs or flumes can also be used) has the following principle.

The measuring, or sampling vessel has such a shape that the content is directly related to the volume of the flow at any moment as well as to the overflow height fixed by the formula: $Q = 1.34\ h^{2.48}$ for a V-notch weir. The frequency of sampling is controlled by an adjustable time clock. In normal circumstances a complete cycle takes two minutes. The accuracy of the apparatus is very high according to frequent tests even over 99 per cent. Maintenance and supervision are negligible.

It is obvious that a certain relationship must exist between production output and pollution-load of the waste water for a certain type of industry. Based upon this principle, Wagner[3] published a list of pollution coefficients for a great number of industries. For the dairy industry these figures are all related to production data, but for other industries they may be related to energy consumption or number of employees. Some river boards and local authorities are using these figures for calculating the purification rates, thus making it an easy and cheap matter of administration.

The calculation unit is normally the inhabitant equivalent (IE). But there is little uniformity about the definition of the IE. Originally the value was given as 54 grams of BOD. Some Dutch river boards however defined the IE according to the formula:

$$1\ \text{IE} = \tfrac{1}{2}\left(\frac{\text{grams BOD}}{35} + \frac{\text{grams SS}}{60}\right)$$

This is based upon the following figures: the domestic sewage of one person per day has a BOD of 35 grams in the settled sewage and a weight of 60 grams for the dry settled solids. From the point of view of costs for purification both factors contribute to the same extent.

A few months ago a new basis was introduced by the Dutch Government. The Dutch Water Pollution Act, which came into force in 1970, has a very long history. As early as 1897 a Bill was introduced in Parliament. Since then, this was repeated at regular intervals but it lasted until 1964 before the final Bill, now being an Act, was introduced. The principle of the Act is that every discharge of polluted water in surface water is forbidden. Under certain conditions consent can be given to the pollutor to discharge his waste water without purification. These consents are given by the Government for the big rivers and canals as well as for the territorial seawater. As for the other streams of mostly local importance, the provincial authority (County Council) or the river boards are nominated. In all cases the pollutor has to pay a polluting tax related to the amount of polluting material in his waste water. In residential areas this tax will be calculated as a certain percentage of the value of the house concerned.

For trade waste there are two rating systems. The first one is based upon regular measuring and sampling of the waste water discharge. The pollution will be calculated as inhabitant equivalents according to the formula:

$$1\ \text{IE} = \frac{\text{grams COD} + 4.57 \times \text{grams N (Kjeldahl)}}{180}$$

This formula is based upon the oxygen demand but not the usual BOD but the COD (dichromate) and upon the oxygen needed for complete oxidation of the ammonium compounds and the organic nitrogen. The figure 180, being the total oxygen demand of one inhabitant, is composed as follows: The BOD of one person per day is taken as 54 grams. For domestic sewage the ratio COD/BOD = 2.5. The COD of 1 IE is therefore $2.5 \times 54 = 135$ grams. The total load of Kjeldahl-nitrogen in the domestic sewage from one person is 10 grams per day. For complete chemical oxidation 4.57 grams of O_2 per gram of nitrogen is needed. For 10 grams also: 45 grams O_2 per IE per day. The two components together make 180 grams.

The second system again is not based upon the measuring of pollution loads but on calculation related to production size. The coefficients are re-calculated on the basis of the new formula, but their reliability is hardly better than the original ones. Investigations some years ago[4] came to the conclusion that there is no rectilinear relation between production-volume and pollution load in the dairy industry. It is sure that this also holds true for other types of agricultural industries e.g. poultry processing plants. The only use co-efficients may have is that they might give an indication as to how successful the internal measures to minimize pollution have been. Also they might be helpful for designing a purification plant for future factories. For the rest all rating and designing should be based upon proportional sampling.

TREATMENT OF DAIRY WASTES

For dairy waste water not all the systems of biological purification that are in use for handling domestic sewage are suitable. A dairy discharges mainly very concentrated waste water, high in organic pollution. From time to time peak load will be discharged. They may be due to internal processes, to seasonal fluctuations, to lack of control or to a 'force majeure' situation such as power collapse. Plant-design must take into consideration these and other 'dairy' characteristics such as the non-pathogenic character of the wastes and the absence of primary sludge and of stormwater.

Besides lagooning and spray irrigation there are in general for the purification of dairy waste waters three reliable systems, alternating double filtration, extended aeration and plastic medium bio-filtration. Only the former two systems are capable of producing a high quality effluent with a BOD figure lower than 20 ppm. Plastic medium filtration can be economically used as a so-called roughening filter. The aim is to cut an original high BOD-concentration by 50–80 per cent, depending on the loading, prior to full biological treatment by the systems already mentioned. This first stage is compact and cheap in operation and diminishes the size of the second stage.

GENERAL DESIGN

1. Alternating double filtration

This system developed as a result of the observation that percolating filters treating sewage, which had become partially choked with deposited solid matter, could be cleared by the application of purified effluent from another filter. A single-stage percolating filter treating dairy wastes will give rise to ponding due to a heavy growth of biological film. It will not be successful in treating milk washings. Double filtration without alternation of the filters is no more suitable a method for treatment of dairy wastes. The double filtration plants have mostly a collecting and/or sedimentation tank. The main purpose however is to equalise the flow as well in quantity as in quality related to BOD-concentration and pH. The retention time may be up to six hours. Average design load of the filters is in the order of 200–300 grams BOD/m^3 filter day. Practical loads of less than half are reported. In all cases, effluents of satisfactory quality are produced, unless the works are overloaded[2, 5].

Compared to the system of extended aeration, this one is in fact rather complicated. A holding tank and two sedimentation tanks are needed. Two pumping stations with recirculation facilities must be built. The interconnecting pipework has to be designed in such a way that filter number one can be put in the number two position and reverse. Last but not least the humus sludge is in fact unstabilised. Buffering of this material gives rise to unpleasant smells.

2. Extended aeration

A treatment plant of this type consists of:

A. Pumping station.

B. Aeration tank, ditch or channel.

C. Final sedimentation tank.

D. Sludge thickening (and holding) tank.

A. Unless there is a sufficient natural difference in height between the end of the central sewer and the point of effluent discharge, a pumping station is necessary. Principally there is no need for any more storage capacity in the pump cellar than is needed for a good pumping operation. As the maximum capacity of the pump rules the size of the final sedimentation tank it can be profitable to make storage provisions for some short peak flows, thus reducing both pumps and tanks. Submerged (underwater) pumps are cheap and reliable. In case of breakdown a reserve pump can be installed in a few minutes. Larger flows can better be handled by 2 pumps, each having 50 per cent of the total capacity needed.

B. The volume of the aeration part can easily be calculated on the basis of 200 grams BOD per m^3 tank (13 lb BOD/1000 ft^3) per day[6]. Higher loadings will cause troubles in sludge quality and quantity, influencing the effluent also and must therefore be avoided. The form of the aeration as well as the type of aerator will be discussed in the next chapter. In case the pollution load exceeds about 1000 kgs of BOD per day, a rather exceptional case in the dairy industry, a more complicated two-stage purification system must be chosen. The first stage in this process can be biofiltration over a plastic medium filter.

C. The final sedimentation preferably has an open connection with the aeration tank. As the flow in dairies can be kept small, an upward flow clarifier (Dortmund tank) is to be preferred. The tank should be designed upon a surface loading of 0.8 m^3/m^2 h and a minimum retention time of one hour, including recirculation of sludge. For large flows any conventional type of scraped circular or rectangular tank will be effective, if only based upon the figures just mentioned. The return of activated sludge from the settlement back into the aeraton can be achieved by means of an archimedean screw. The capacity of the screw must be equal to that of the raw water pump(s). Recirculation of less than 100 per cent is effected by limiting the amount of sludge withdrawn from the settling tank.

D. The sludge tank can be a combined thickening and holding tank, for those cases where the sludge in liquid form is disposed of in agriculture. Then some storage for non-delivery periods must be available. Local situations will determine the length of these periods and thus the storage capacity. Design can be based upon an average dry matter sludge production of 20 per cent of the BOD-load handled and a final product with 3–5 per cent dry matter. The supernatant is taken back into the purification plant. The sludge has this average composition in per cent of the dry matter: Organic material 75 per cent, N 6.1 per cent, P_2O_5 5.5 per cent, CaO 7.2 per cent and K_2O: traces.

3. Plastic medium biofiltration

This is one of the noteworthy recent innovations in the technology of waste water treatment. Details about the materials used, surface area, void space and weight are published elsewhere[7,8]. The economy of this type of filter is evident, specially at high BOD-concentrations. There is of course a relationship between loading and BOD-removal.

A fairly normal loading is 2–4 kg BOD/m^3 filter, day, resulting in a 80–50 per cent removal. Two-staged systems, with an extra sedimentation unit between filters 1 and 2, will bring this percentage near to 90 per cent. These loadings are about ten or more times higher than those used in conventional biofiltration[9]. Maximum efficiency can only be attained by complete wetting of the material which means in general a hydraulic load of 1.5 m^3/m^2/h.

Recirculation of effluent in the order of 1:1 or 1:2, depending on the influent volume must be taken into account.

Use of this system can be made in the following situations:

1. Free discharge of polluted water at a rather high financial burden based upon BOD-load.
2. Cutting the BOD-load in an existing overloaded private or public purification plant.
3. Reducing an original high concentrated waste prior to complete treatment in a conventional type of purification plant. This in general does pay for large polluting enterprises only. It complicates a small plant too much.

Provisions however must be made to dispose of the humus sludge. As it is not stabilised it must be discharged daily or it must be aerated in a separate tank during 5–10 days in order to make it suitable for storing during those periods that agriculture cannot spray it on the land.

Construction of biological part of extended aeration

The basic form of extended aeration plants for Dutch dairies is the oxidation ditch with a central island. Water depth is about 1.00–1.25 m. Aeration takes place by means of a brush or cage rotor supplying oxygen at a rate of twice the daily BOD load. This OC/load ratio of two proved to be a completely safe design. In practice it is possible to supply during certain periods less than the maximum oxygen input.

A cheaper construction simplifies the central island into a longitudinal concrete baffle. In the bends on both ends of the tank mid-feather walls must be constructed to prevent loss of stream energy in the system. A minimum stream velocity of 0.3 m per second is required to prevent settling of the activated sludge. The outer banks are sloping 1:1 for easy construction. To save building site the ditch can be folded in such a way that 4 parallel canals are formed, connected on one side by a big half circle and the other side by two small half circles. In all these cases, using a brush as aerator, depth is limited to about 1.25 m, so the total water surface is still rather large.

To make a real gain limiting the area needed for the plant the tank form can be chosen. A square tank can have a depth of about 1 fifth of the length of one side. Depth may go up to about 5 m. Aeration now takes place by means of a turbine, installed at the centre of the tank.

A completely new form, called 'Caroussel', combines both the principle of a ditch with the turbine aeration system. It consists of a relatively small rectangular tank, connected with an oxidation ditch of greater depth than usual, 2.50–4.00 m. The advantage of this system is the better equilibrium between energy needed for aeration and that for suspension turbulence. The quantity of mixed liquor in an extended aeration plant is so large that the aerator must be oversized compared to its oxygenation capacity only to reach the minimum suspension turbulence. 8 watts/m^3 energy is in a conventional oxidation ditch mostly sufficient for the oxygen transfer as well as for generating the turbulence. In square aeration tanks the safe energy limit is 15 W/m^3 and is mainly determined by turbulence requirements. For sludge mineralisation a still higher energy level is recommended.

The Caroussel constructors even claim a sufficient energy level of 3–5 W/m^3. The eventual profit of Caroussel must be derived from a lower energy consumption. Experience however is too short to give reliable information. The main advantages of extended aeration are:

1. Uncomplicated system.
2. Producing a high standard effluent.
3. Resistant to extreme shock-loading, up to six times the average daily load.
4. Producing well stabilized sludge with constant good settling properties in limited quantities.

The average influent and effluent quality of the Dutch dairy plants is illustrated in the next table.

Table 2. Dairy waste treatment

ppm	Influent	Effluent
COD	1700	50
BOD	1000	10

The extended aeration system proved to have the same reliability for other types of industrial waste water. Examples are reported from slaughterhouses, tanneries[10], and farm waste plants[11, 12]. Whenever the plant is designed upon a BOD-sludge load of 50 g/kg dry matter per day effluent quality is satisfactory.

Other systems

Lagoons can be used to treat dairy wastes under favourable climatic conditions. Eventually they can be mechanically aerated. There is however only a little reliable information to be found about this system in the literature[13].

Spray irrigation is used in many parts of the world to tackle the problem of dairy waste waters. The system cannot be used everywhere. The quality of the soil and topography are decisive for the system. This partly holds also for the climate. During frost periods the system is impracticable.

The wastes do have a certain value as fertilizers specially for grassland. In moderate climates the volume of the waste to be dosed yearly will hardly exceed 1000 mm[14]. An average dose of 300 mm/year still makes the system economically profitable, considering the many restrictions.

Costs comparison

Figures concerning costs which have international validity will be difficult to give. There is too much difference, even in the European countries, in price level for building, energy and labour, in capital interest and so on. However, there is a continuous rise in labour, and therefore in building costs, while energy tends to be rather constant in price. This must lead the designer to a type of purification plant that is easy to construct, firmly built but not meant for eternity and uncomplicated in supervision and control. The energy consumption is less important.

For dairy waste water such a type is the one-stage extended aeration plant. It depends on the size of the pollution load whether a two-stage plant, plastic filtration + extended aeration, will be cheaper. Under Dutch circumstances this load may have its limit by about 1000 kg BOD per day. Total investment for a 'turn-key' plant in the case of a normal dairy will be in the order of 200–250 U.S. dollar per kg BOD day capacity. I believe that this figure holds true at least for UK, German Federal Republic, Belgium, France and Austria.

In calculating operation costs the yearly energy consumption of an extended aeration plant may be taken as 400 kWh/kg BOD eliminated daily. In the case of a filtration plant this figure will be less than half, including the energy needed for stabilisation of the humus sludge.

Supervision, cleaning and control will definitely not take more than half a man. Sludge disposal will be calculated for a certain price per m^3, based upon tanker transport to farmers over an average distance. The quantity, in the case of extended aeration, will be about 30 per cent dry matter weight of the BOD load eliminated. The volume to be transported is about 30 times this figure, based upon a slurry with three per cent dry matter only.

Filtration plants produce about the same or somewhat smaller sludge quantities. For sludge disposal over longer distance use can be made of decantors. Without the help of flocculating agents the stabilized sludge can be concentrated to about 8–10 per cent dry matter, twice as much as with an overflow-thickening tank. Decantors can reduce the volume by 50–70 per cent. The recovery of the decantor used in this way is low, but the major problem is that generally the total amount of sludge to be handled is too small compared with the capacity of the decantor. Only for the very large plants with or without using flocculating agents, might this system be profitable.

Experience in Holland and elsewhere showed that dairy wastes can be purified to a constant high quality effluent in extended aeration plants. In such a well designed plant the total costs per kg BOD removed or per m^3 waste water handled, are about half of the costs usual for public plants. Disposal in a local sewer, leaving the purification to the authority, will indeed mostly be the easiest way to solve the problem. However the factory must always comply with requirements as may be placed upon it. It is questionable in how far this solution will also be the most economical one. The old statement that a combined treatment of domestic sewage and trade waste always will be cheaper and better does not hold true.

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