Biological Process Design for Wastewater Treatment
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Lecture: 38
Management of Wastewater from Dairy Industry

Welcome everyone in this NPTEL Online Certification Course on Biological Process Design for Wastewater Treatment. So, in the previous a lecture we studied regarding the SD, sustainable development and EIA. From today we are going to study some case studies with respect to the management of wastewater in some industries. So, today we are going to take the case of dairy industry, how the wastewater is managed in the dairy industry.

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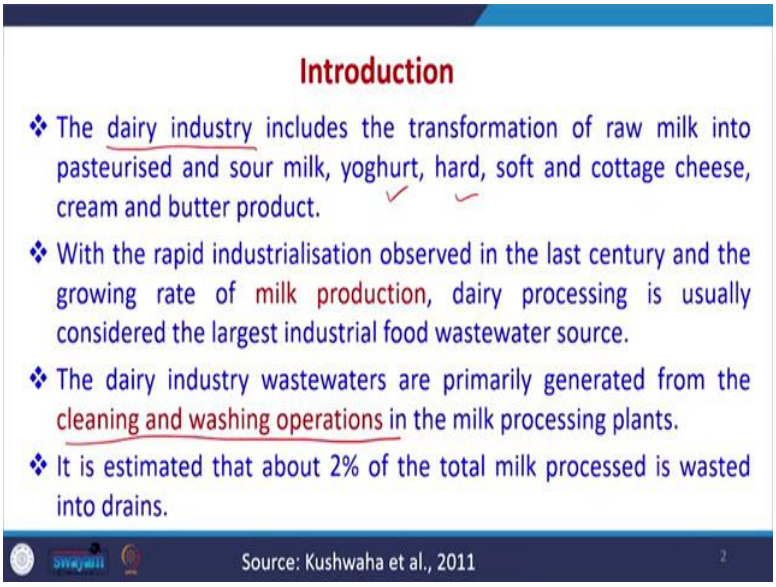

So, the dairy industry includes the transformation of raw milk into pasteurised or sour milk, then we can produce yogurt, hard, soft, and cottage cheese, then cream and butter products. So, a dairy industry can incorporate any of these products. With the rapid industrialization observed in the last century and the growing rate of milk production, the dairy processing is usually considered the largest industrial food wastewater source.

So, a lot of wastewater is generated in the dairy industries and during the milk production. The dairy industry wastewaters are primarily generated from cleaning and washing operations in the milk processing plants. It is estimated that two percent of the total milk process is wasted into drains, this is the issues which are there with the respect to dairy industry. Now, the dairy wastewater are characterized by high biological oxygen demands. So, they have very high BOD, certainly they have chemical oxygen demand as well.

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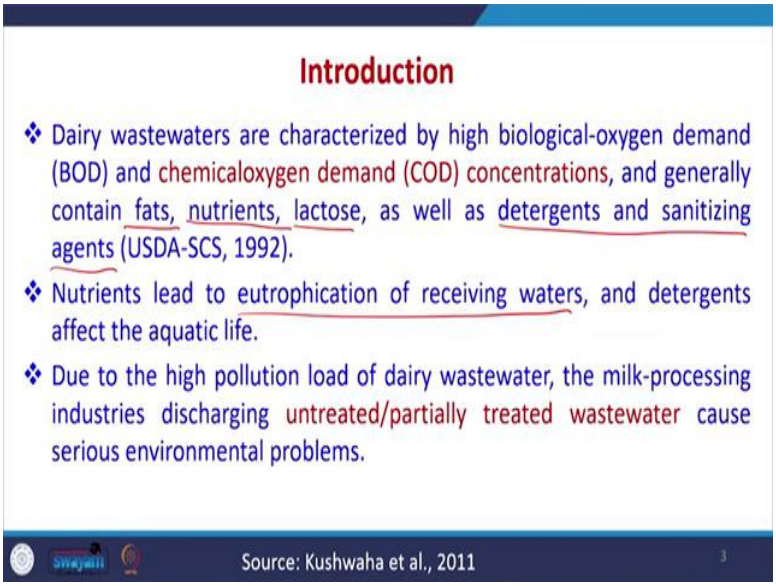

And generally, the water will contain fats, nutrients, lactose as well as detergents and sanitizing agents because they are used in the cleaning operations, etc., so, these are the various characteristics of the dairy industry wastewater. Now, the nutrients which are present in the dairy wastewater if they are not taken care of, they will lead to eutrophication of the receiving waters and detergents will also affect the aquatic life.

Due to high pollution load of the dairy wastewater, the milk processing industry is discharging, untreated or personally treated wastewater can cause lot of serious environmental problems. So, and since the dairy industries are generally low, they always wish that the minimum cost they should incur on the wastewater treatment.

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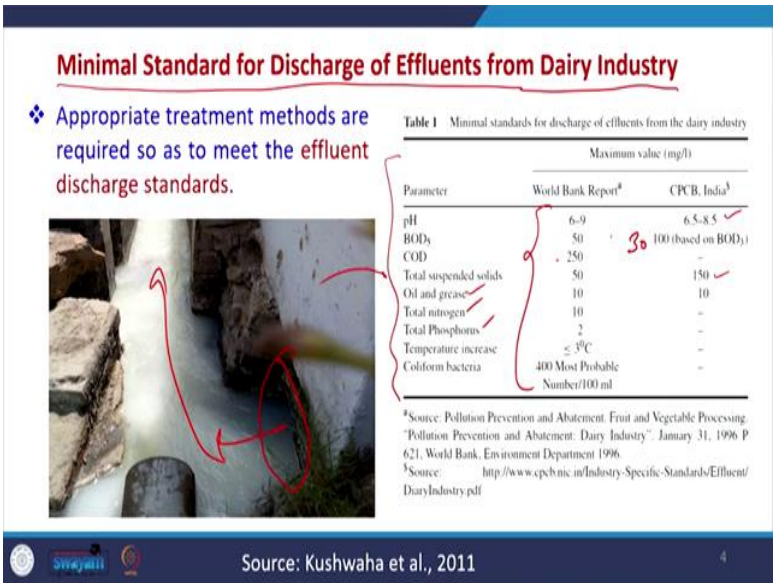

Now, we can see here one photograph where some dairy industry is there across this wall and this is discharging a water from this source and this wastewater is going into the open channel. So, appropriate treated methods are required for treatment of such wastewater which are generated in such industries, so as to meet the effluent discharge standards.

So, in India we have the minimal standard for discharge of effluents from dairy industry and these standards are listed here that any wastewater which is generated in the industry has to treat the water and it should meet certain standards. So, the pH should be in the range of 6.5 to 8.5, the BOD should be less than hundred then the total suspended solid should be less than 150.

The World Bank also has given certain standards like the pH should be between 6 to 9 the BOD should be less than 50, in fact, the BOD has now been minimized up to 30 that the BOD has to be less than 30. COD is 250 is COD in case in India it is 100. So, we have different we can see total phosphorus total nitrogen oil and grease these are important parameters that have to be taken care of in the treatment of dairy industry wastewater.

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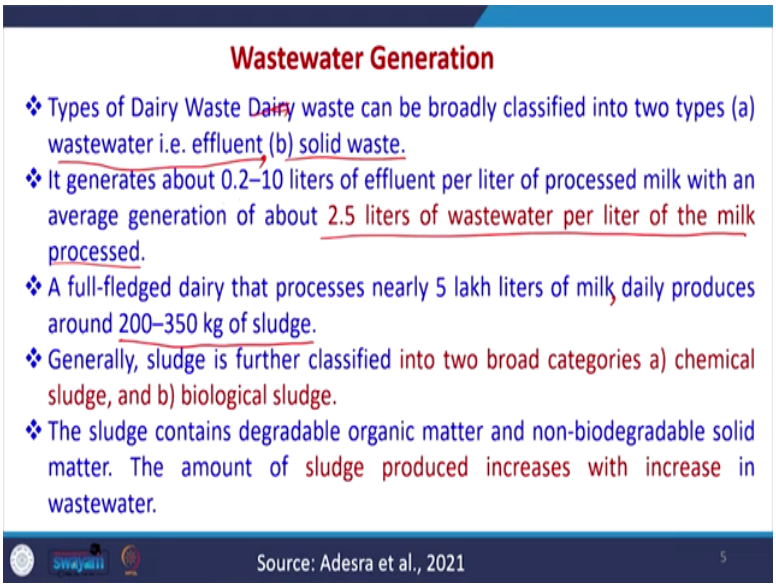

Now, wastewater generation. Types of dairy waste that can be broadly classified into two types, wastewater can be two types that is effluent. So, we have wastewater which is coming and we have solid waste which is coming. So, from the dairy industry a waste can be classified into two types it generates 0.2 to 10 litre of effluent per litre of the processed milk.

So, that means depending upon the technology, we can generate from 0.2 to 10 litre of effluent per litre of processed milk with an average generation of 2.5 litre of wastewater per litre of the milk process. So, that means if we are processing 1000 litre of milk. So, will be generated 2500 litre of wastewater. A full-fledged dairy that processes nearly 5 lakh litre of milk daily produces. So, it will produce around 200 to 350 kg of sludge as well.

So, that is very large quantity of sludge is also produced. So, sludge management in the dairy industry is also very important. Generally sludge is further classified into two broad categories, the chemical sludge and biological sludge. The sludge that contains degradable organic matters and non-biodegradable solid matter, it will contain both at material. The amount of sludge produce increases with increase in the wastewater.

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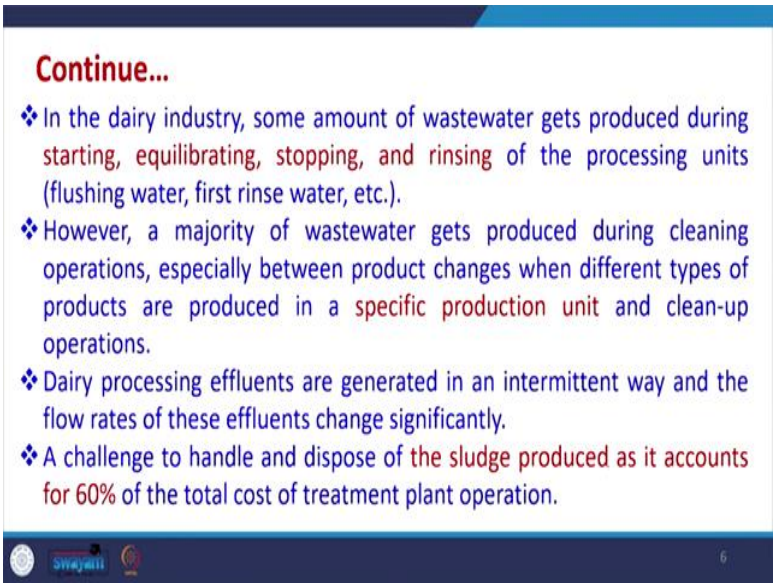

In the dairy industry some amount of wastewater gets produced during the starting equilibrating stopping and rinsing of the processing unit. So, the processing unit is very important where flushing of water, rinsing is done using water. So, they generate lot of wastewater. However, the majority of wastewater gets produced during cleaning operations, especially when the product changes when different types of products are produced in a specific production unit.

And during the clean-up operation we produce lot of fish water. The dairy processing effluents are generated in an intermittent way and the flow rates of these effluents changes significantly. A challenge to handle and dispose of the sludge produce as it accounts for 60 percent of the total cost of the treatment. So, all these are the challenges which are there with respect to dairy industries.

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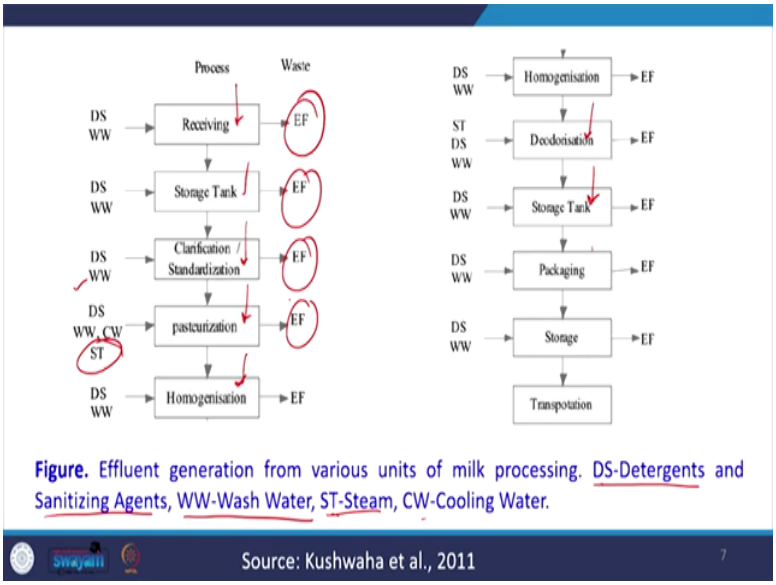

Now, the effluent generation from various units of the milk processing. So, here like DS stands for detergents and sanitizing agents. So, we use processes which are there receiving the water then storing it in the tank, then clarification and standardization, then pasteurization homogenization, after that deodorization, again storage, packaging, further storage and transportation.

So, in all these processes the wastewater is generated because we use the washing water, the wash water which is represented by WW, DS stands for detergents and sanitizing agents, ST for steam during pasteurization, we have steam which is used, then CW stands for cooling water because we have to use the cooling water also some other places. So, in all these processes we generate effluents which are getting generated.

So, that is why, overall we generate lot of effluent around 2.5 times the amount of or the volume of the milk process.

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Now, we can see here the effluent getting generated from some industries, you can easily see, the water which is coming to this unit it is milkish in nature. So, because it contains lot of milk. Then it is being stored here, further it is treatment is done. During treatment also, we can see lot of milk present in the water.

So, these are the photograph of actual milk processing industries. We can see how the water looks like and certainly since many of the plants are very very small. So, they have very little laggardness toward treatment of water and many a times, they discharge the wastewater without treatment also.

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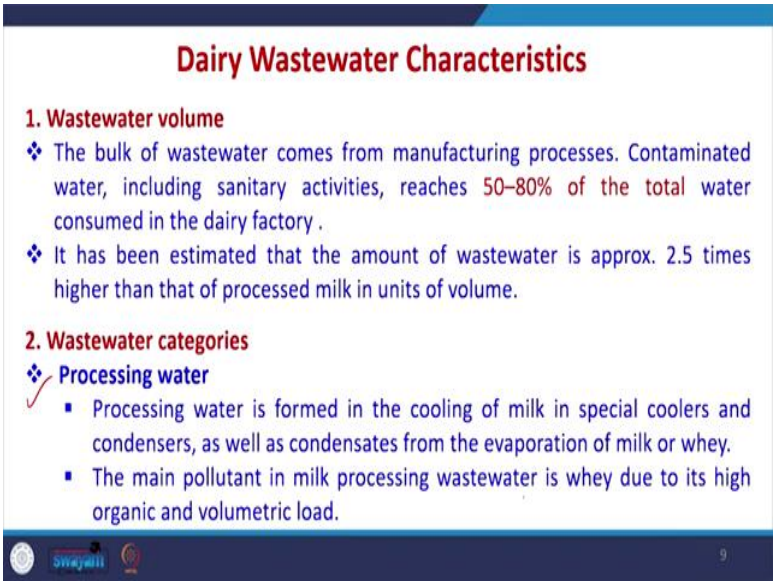

Now, the dairy wastewater characteristics. The wastewater volume. So, the bulk of wastewater comes from manufacturing processes, contaminated water including sanitary activities reaches 50 to 80 percent of the total water consumed in the dairy factory. It has been estimated that the amount of wastewater is approximately 2.5 times higher than the milk process in terms of volume.

Now, wastewater categories, we can have processing water, a processing water is formed in the cooling of milk in special coolers and condensers as well as condensates from evaporation of the milk whey. The main pollutants in the milk processing wastewater is whey, due to which its high organic and volumetric load. So, this whey is the major issue.

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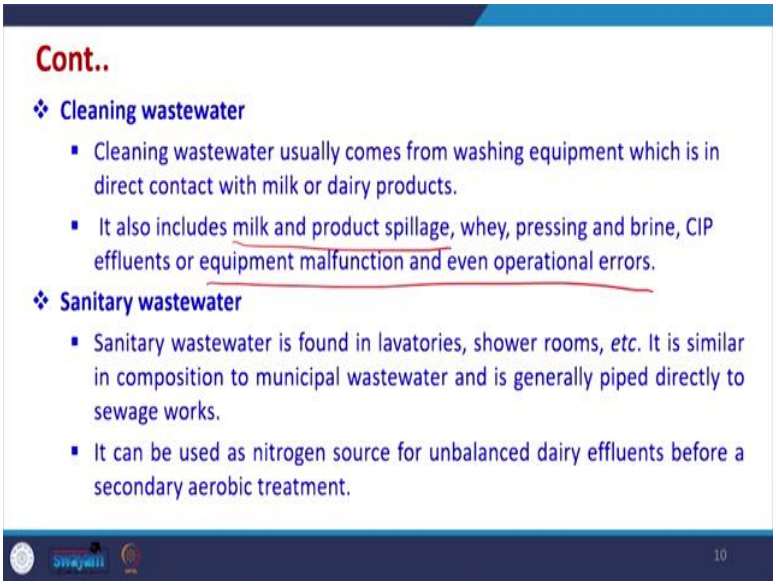

Then we have cleaning wastewater, like cleaning wastewater usually comes from washing equipment which is in direct contact with the milk or dairy product. It will also include milk and a product spillage, whey, pressings, brine, CIP effluents or equipment malfunctions and even operational errors. So, all these are we will count into cleaning wastewater.

Then because this is the industry, so certainly sanitary wastewater will also be getting generated, it is found in the laboratories, shower rooms, etc. It is similar in composition to the municipal wastewater and is generally piped directly to sewage works also, if the ETP is there, it can be used as a nitrogen source for unbalanced dairy effluents before a secondary aerobic treatment happens. So, these are the different types of wastewater which are generated in the dairy industry.

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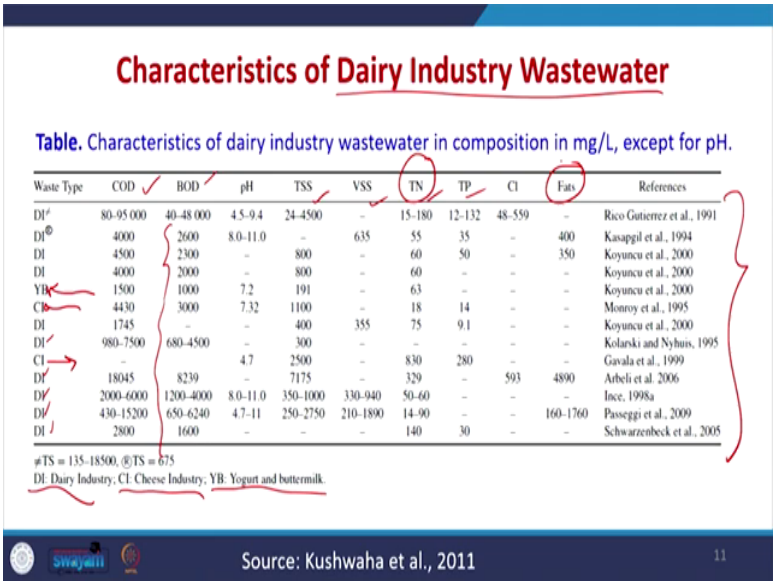

These are the characteristics of the dairy industry wastewater. So, here there is some differences there. So, we have DI, stands for dairy industry wherever they are limited, CI where the cheese processing industry is more. So, CI is you can see that CI here, similarly YB stands for yogurt and buttermilk. So, when the yogurt and butter milk is the main thing. Now, these characteristics have been reported in these literatures and we have listed here.

So, we can see the COD, BOD range. So, it is very high, BOD value is varying from 40 to 48 thousand. So, you can see 2600, 2300, 2000, 1000. So, bog is beyond 1000, virtually all the cases. The pH is also varies, we have TSS, VSS, total nitrogen, total phosphorus, all these things are very important. So, nitrogen content certainly will be high. Fats will also be present in the daily industry wastewater.

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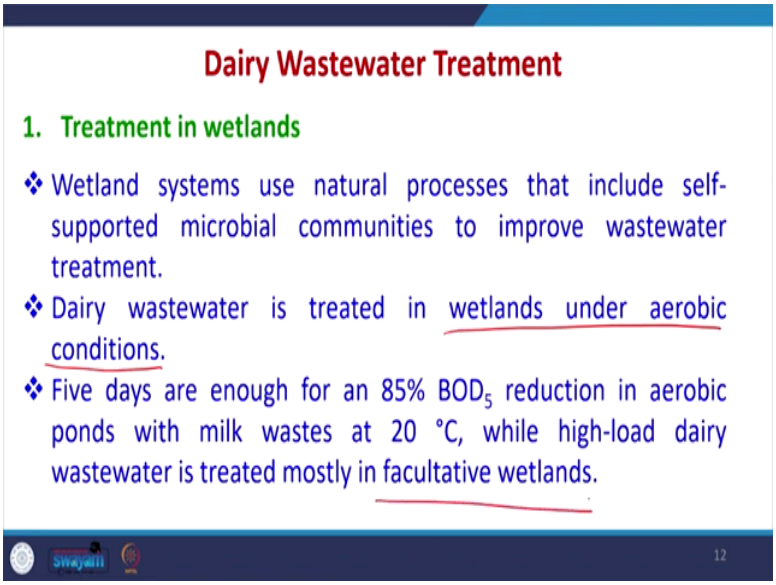

Now, once this wastewater has been generated, we have to go for the treatment of the wastewater and this can be performed in different ways. So, treatment in wetlands, wetland systems use natural processes that include self-supported microbial communities to improve the wastewater treatment. Dairy wastewater is treated in wetlands under aerobic conditions.

So, five days are enough for an 85 percent BOD reaction in aerobic ponds with milk waste at 20 degrees centigrade, while high-load dairy wastewater need to be treated mostly in the facultative wetlands. So, in the wetlands some treatment can be done, then purification in urban and in factory wastewater treatment plants.

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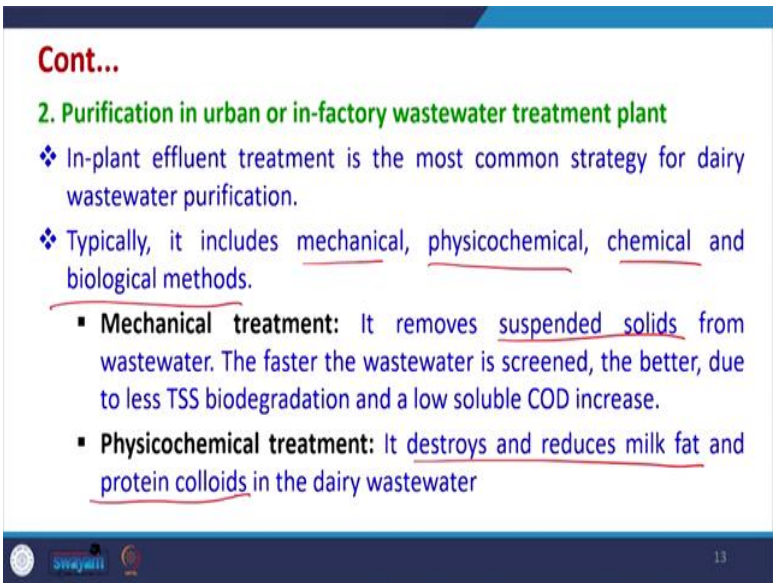

So, in plant effluent treatment is the most common strategy for dairy wastewater purification. Typically it includes mechanical physicochemical, chemical and biological methods. So, various methods will be used for wastewater treatment. So, mechanical treatment will try remove suspended solids from wastewater.

The faster the wastewater is screened, the better due to the less TSS biodegradation and low soluble COD increase. So, this mechanical treatment is done. After that we can go for physicochemical treatment which destroys and reduce is the milk fats and protein collides in the dairy industry. So, we can do go for physico chemical treatment.

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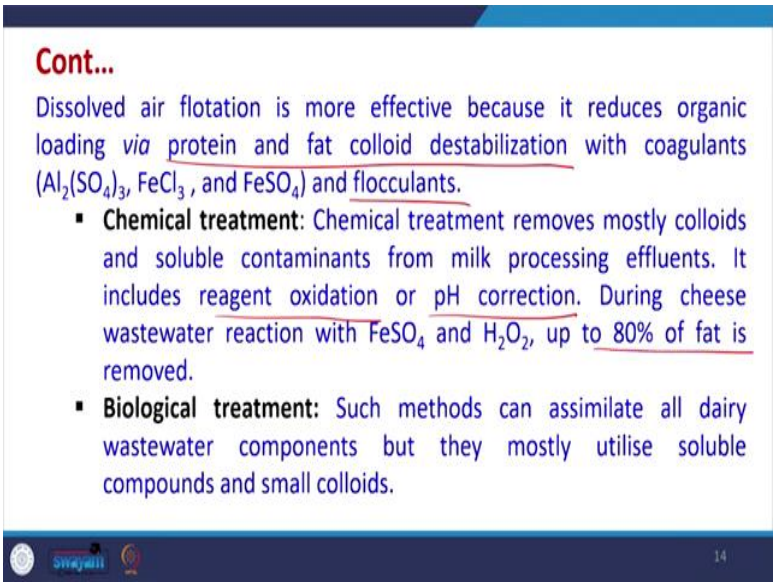

Dissolved air flotation is the most effective because it reduces the organic loading via protein and fat colloid destabilization with coagulants such as coagulants, such as aluminium sulfate, ferric chloride, ferrous sulfate, and the flocculants as well. Then we can go for chemical treatment which removes mostly collides and soluble contaminants from milk processing effluence.

It includes reagent oxidation or pH correction. During wastewater reaction with SO_4 and H_2O_2, up to 80 percent of the fat gets removed. So, it has been reported, then we go for biological treatment. So, we can assimilate all dairy wastewater components, but mostly utilize soluble compounds and small collides during the biological wastewater treatment.

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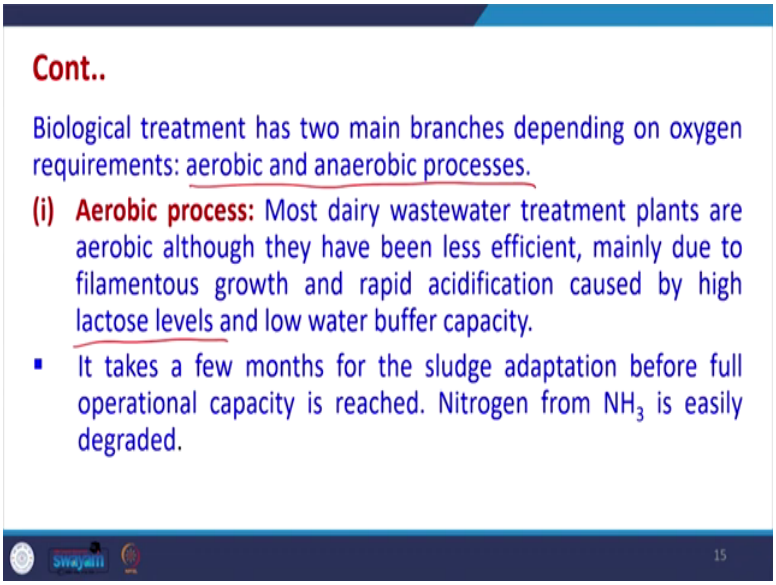

This is, the biological treatment will now include two types of approaches, one depending upon oxygen requirement. So, we can have aerobic and anaerobic processes. So, aerobic processes mostly dairy wastewater treatment plants are aerobic although they have been less efficient and mainly due to filamentous growth and rapid acidification caused by the lactose levels and low water buffer capacity.

Since the buffer capacity is low and the lactose levels are high, so lot of filamentous growth happens during the treatment via aerobic method. So, they are generally lesser effective as compared to anaerobic treatment. Aerobic treatment takes a few months for the sludge adaptation before the full operational capacity is reached. Nitrogen from ammonia is, can be easily integrated using the aerobic processes.

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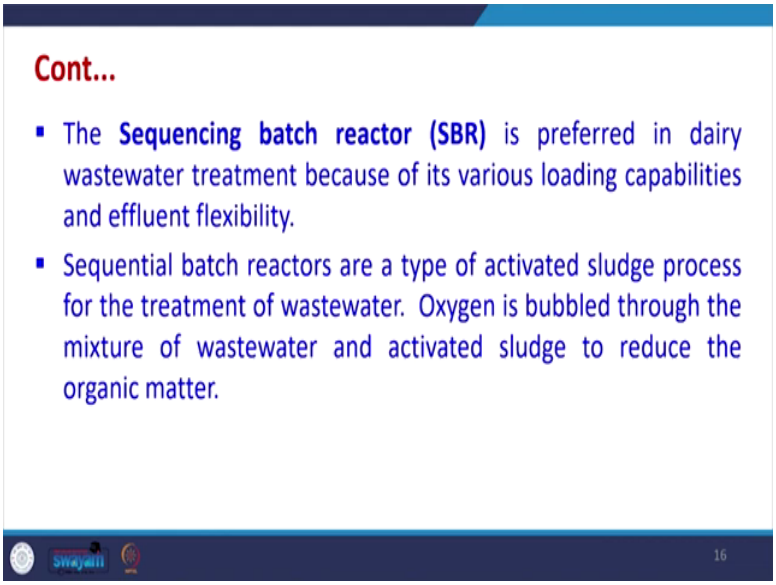

Now, the sequential batch reactor is preferred technology in dairy wastewater treatment by aerobic method because it has the capability of accepting various loading capacities and the effluents of flexible nature can be treated in the sequential batch reactor. So, if we have to adopt for aerobic treatment, SBRs could be one of the preferred techniques for treatment using the aerobic method.

Sequential batch reactors are a type of activated sludge processes for the treatment of Wastewater. Oxygen is bubbled to the mixture of wastewater and activated sludge to reduce the organic matter. So, SBR we have already studied in detail in one of the lectures. So, we can use that technology for dairy wastewater treatment. So, these are the different phases already we have studied, we have fill phase in the SBR process.

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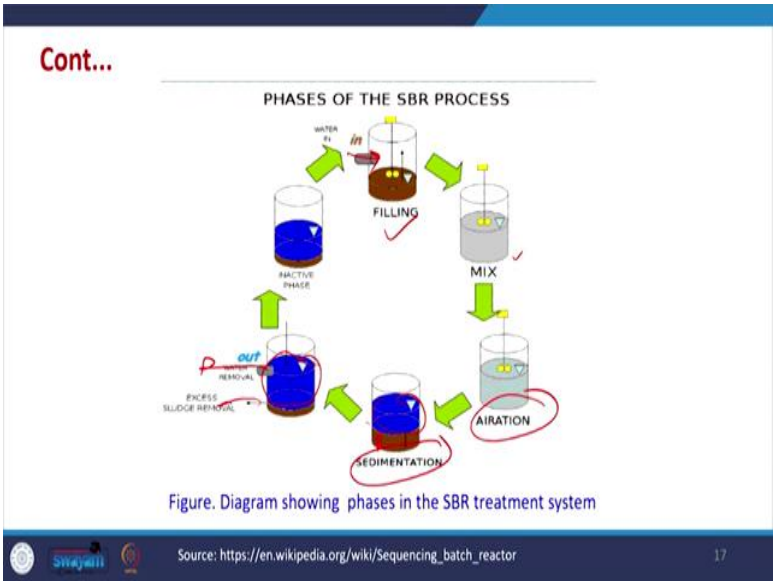

Then we have a mixing process where mixing is done. So, in this case the water is coming in. So, this is there, then we have mixing after that the aeration is being done and then the sedimentation after treatment of sedimentation, the sludge is here the blackish one, the and then the brownish one and the blue is the wastewater and the wastewater treatment has happened that is why it has become blue.

So, this is the treated waste water, this will be removed and the excess sludge will also be removed and then inactive phase will be there where the reactor may be kept idle for some time depending upon, what are the retention times etc., and how the treatment is happening, now this is the SBR.

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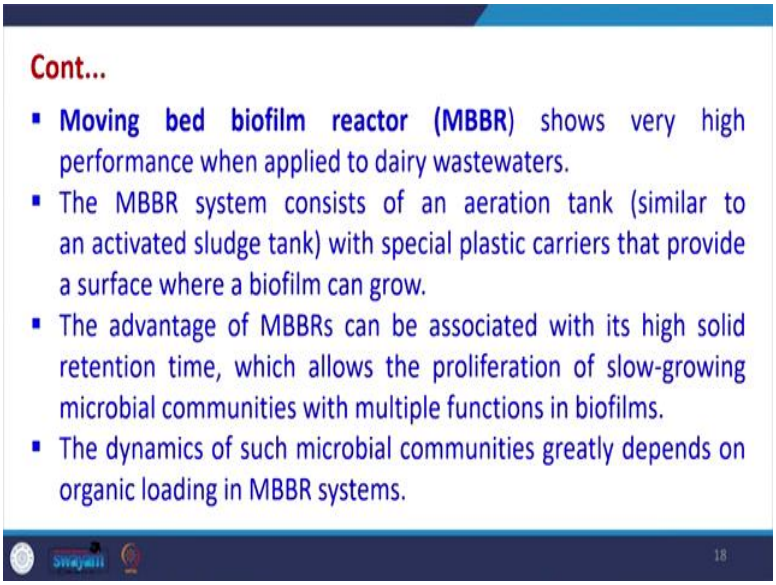

Now moving bed biofilm reactor also shows very good performance when applied for daily wastewater. The MBBR system for this also we have studied in detail, consists of an aeration tank similar to activated sludge tank, with a special plastic carriers that provide a surface with biofilm where the biofilm can grow.

The advantages of MBBR can be associated with its high solid retention time, which allows the proliferation of slow growing microbial communities with multiple functions of biofilm. The dynamics of such microbial community generally depends upon the organic loading in the MBBR system. So, along with SBR, MBBR is also good technology.

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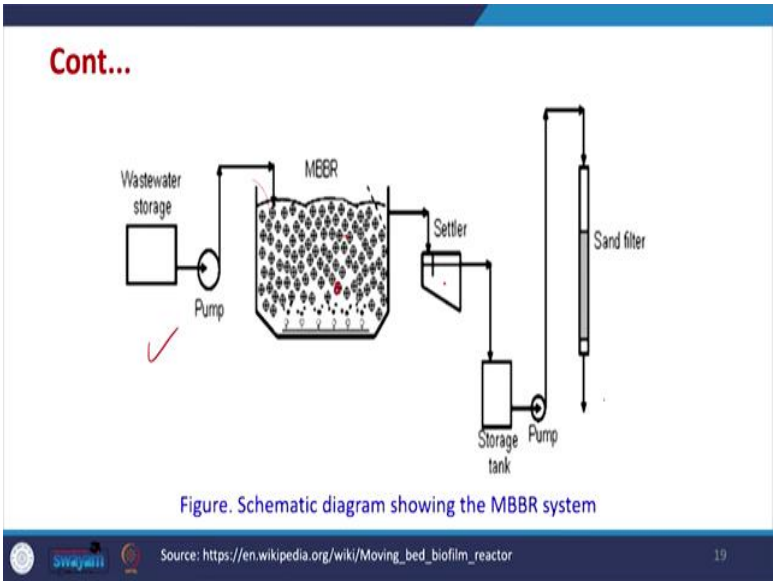

And we can see here the wastewater storage, this is activated sludge process in a way where on the packing material different bacteria have grown and the treatment will happen here and then the wastewater will be settled and it the sludge will be reduced and then the wastewater can be stored and further may be filtered through the sand filter. So, this is the treatment method via MBBR technique for daily wastewater treatment.

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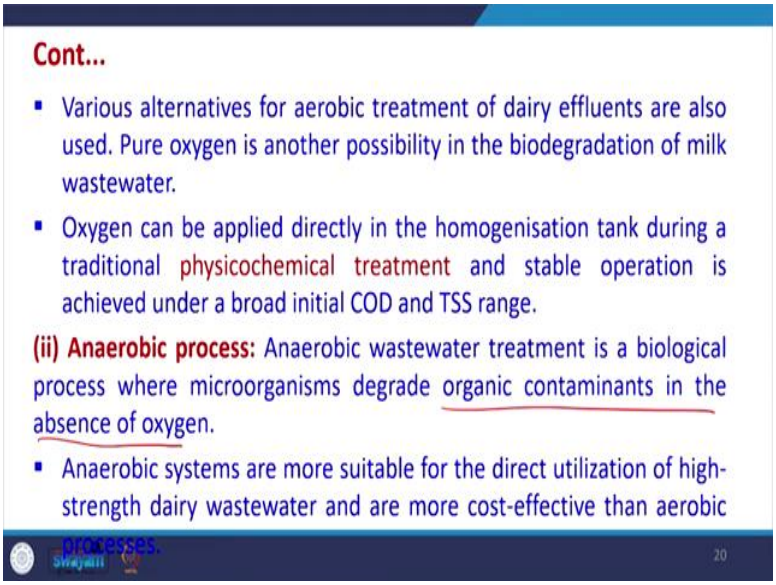

Whereas alternatives for aerobic treatment of dairy effluents are also used, like pure oxygen is another possibility in the biodegradation of milk wastewater. Oxygen can be applied

directly in the homogenization tank due to traditional physicochemical treatment and stable operation is achieved under broad initial COD and TSS range.

So, this is there. Now we can adopt anaerobic processes also for treatment of dairy wastewater. So, in this case the anaerobic wastewater treatment is a biological process where microorganisms degrade organic contaminants in the absence of oxygen. So, anaerobic systems are more suitable for direct utilization of high strength dairy wastewater and are more cost effective than aerobic methods.

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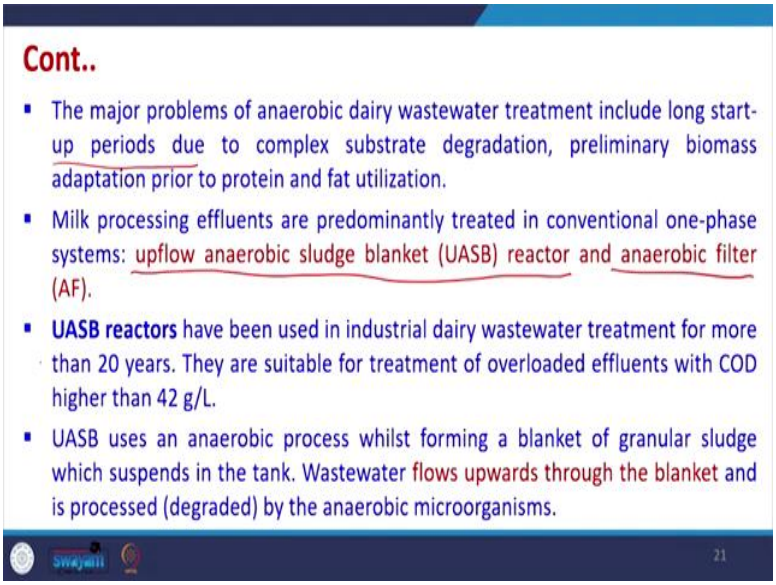

The major problems which are associated with anaerobic treatment are include like long start-up periods because acrylization will be longer than a preliminary biomass adaptation prior to protein and fat utilization. So, the long start-up period is one of the drawbacks. Milk processing effluents are predominantly treated in the conventional one phase systems like UASB reactor.

So, we can use upflow anaerobic sludge blanket reactor or anaerobic filter reactors also for treatment of dairy wastewater. UASB reactors have been used in the industry dairy wastewater treatment for more than 20 years and they are suitable for treatment of overloaded effluents with COD higher than 42 gram per litres also.

So, UASB uses an anaerobic process while forming a blanket of granular sludge, which suspends in the cylinder and wastewater flows upwards through the blanket and is processed

by the anaerobic microorganisms. So, we have studied UASB reactor in detail, you can go back and study UASB reactor the lecture and understand.

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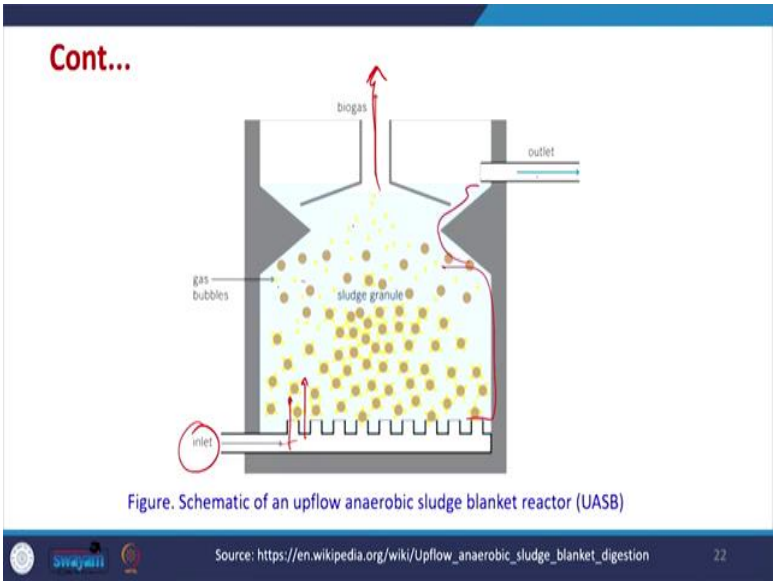

So, already this we have studied. So, the inlet for whey reactor is here, the wastewater goes up, this is the sludge blanket, which contains anaerobic granules. When the wastewater is passing through that the treatment happens. So, lot of gas formation also happens. So, we can see the gas bubbles yellowish in nature.

The biogas will be taken out from here because methane, etc., will be formed and the treated wastewater will go from the side and it can be treated. So, you can refer to the UASB lecture to further understand in detail the UASB reactor operation.

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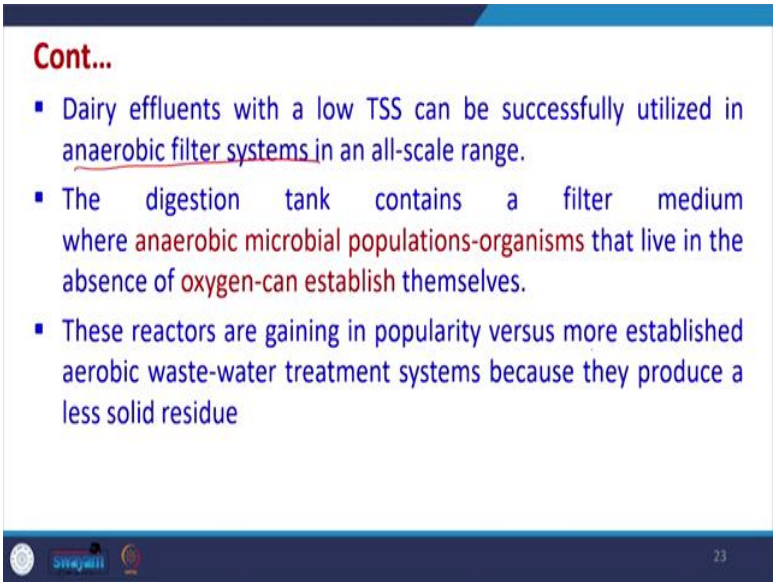

Dairy effluents with low TSS can be successfully utilized in the anaerobic filter system in all scale range. So, we can use the anaerobic filter also. The digestion tank contains a filter medium where anaerobic microbial population organisms live in absence of oxygen. Now, these reactors are gaining in popularity versus more established anaerobic wastewater treatment system because they produce less solid residue. So, this is there.

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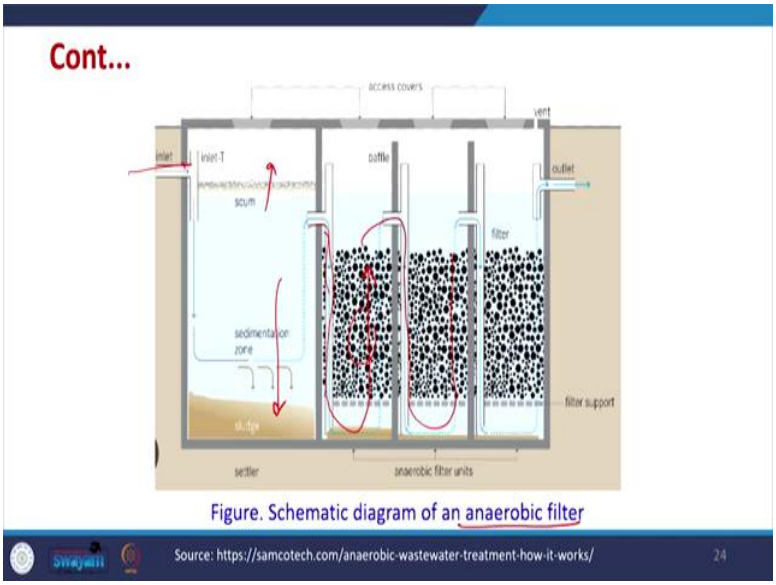

Now, this is the schematic diagram of anaerobic filter. So, here you can see the inlet is there and here some sedimentation is happening, the scum is going up and here the sludge is

getting formed, the water is going again to the filter. So, we have anaerobic granules, which are there. So, water is passing through the granules, you can see up.

The treatment will happen during this. Again it will pass through another set of granules, again to third, and finally the, it will go out and. So, these are the anaerobic filters which can be used for treatment of wastewater, in particular the dairy industry wastewater.

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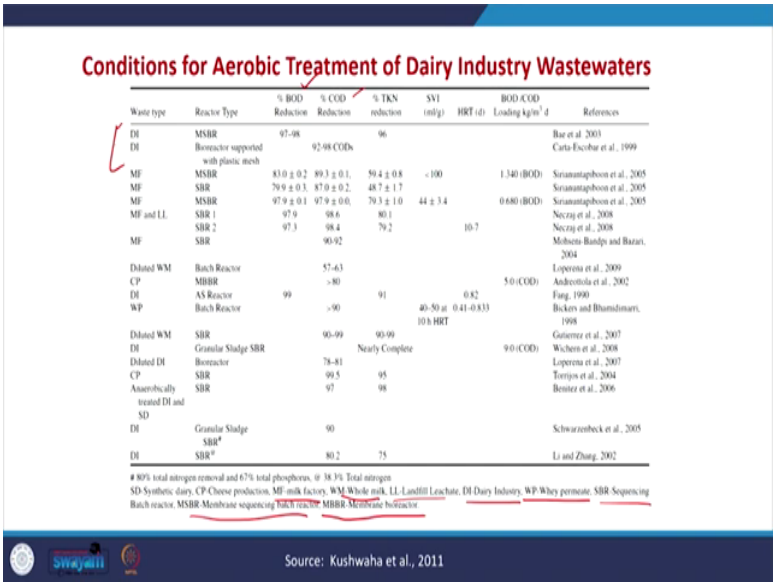

Waste type	Reactor Type	% BOD Reduction	% COD Reduction	% TKN reduction	SVI (ml/g)	HRT (d)	BOD /COD Loading kg/m³ d	References
DI	MSBR	97–98		96				Bae et al. 2003
DI	Bioreactor supported with plastic mesh		92-98 CODs					Carta-Escobar et al., 1999
MF	MSBR	83.0 ± 0.2	89.3 ± 0.1,	59.4 ± 0.8	< 100		1.340 (BOD)	Sirianuntapiboon et al., 2005
MF	SBR	79.9 ± 0.3,	87.0 ± 0.2,	48.7 ± 1.7				Sirianuntapiboon et al., 2005
MF	MSBR	97.9 ± 0.1	97.9 ± 0.0,	79.3 ± 1.0	44 ± 3.4		0.680 (BOD)	Sirianuntapiboon et al., 2005
MF and LL	SBR 1	97.9	98.6	80.1				Neczaj et al., 2008
	SBR 2	97.3	98.4	79.2		10-7		Neczaj et al., 2008
MF	SBR		90-92					Mobseni-Bandpi and Bazari, 2004
Diluted WM	Batch Reactor		57–63					Loperena et al., 2009
CP	MBBR		> 80				5.0 (COD)	Andreottola et al., 2002
DI	AS Reactor	99		91		0.82		Fang, 1990
WP	Batch Reactor		> 90		40–50 at 10 h HRT	0.41–0.833		Bickers and Bhamidimarri, 1998
Diluted WM	SBR		90–99	90-99				Gutierrez et al., 2007
DI	Granular Sludge SBR			Nearly Complete			9.0 (COD)	Wichern et al., 2008
Diluted DI	Bioreactor		78–81					Loperena et al., 2007
CP	SBR		99.5	95				Torrijos et al., 2004
Anaerobically treated DI and SD	SBR		97	98				Benitez et al., 2006
DI	Granular Sludge SBR#		90					Schwarzenbeck et al., 2005
DI	SBR@		80.2	75				Li and Zhang, 2002

80% total nitrogen removal and 67% total phosphorus, @ 38.3% Total nitrogen
SD-Synthetic dairy, CP-Cheese production, MF-milk factory, WM-Whole milk, LL-Landfill Leachate, DI-Dairy Industry, WP-Whey permeate, SBR-Sequencing Batch reactor, MSBR-Membrane sequencing batch reactor, MBBR-Membrane bioreactor

Now, the conditions which are there for aerobic treatment of dairy industry wastewater as well as the anaerobic treatment of dairy industry wastewater are listed here, which have been reported in the literature. So, depending upon the different types of wastewater, the DI, MF, etc. So, like MF stands for milk factory, then WM stands for whole milk, then the landfill leachate dairy industry are the V permeate.

So, we have different abbreviations which are given here. We can use the SBR technology, the membrane sequencing bisector, membrane bioreactor, all those techniques have been used and they are reporting BOD directions, COD direction in various ranges. So, depending upon the characteristics and the type of technology that we are using, we can adopt different parameters and thus we can treat the water using aerobic method.

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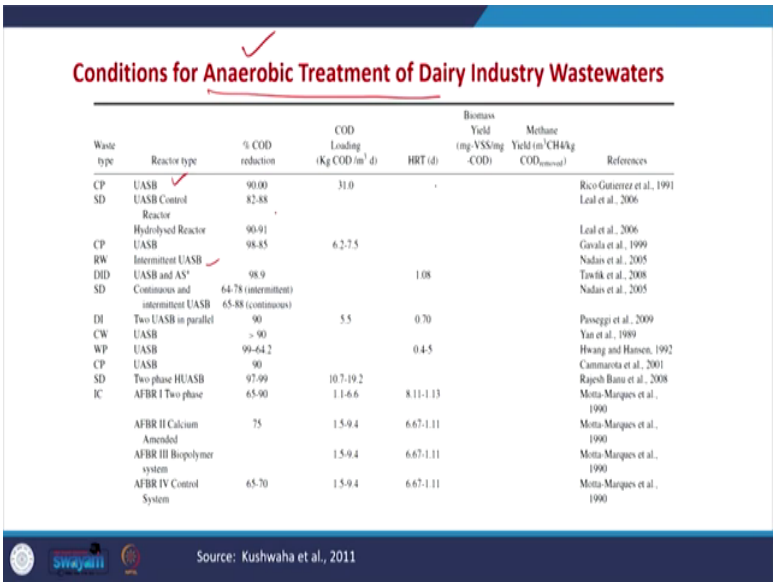

Waste type	Reactor type	% COD reduction	COD Loading (Kg COD /m^3 d)	HRT (d)	Biomass Yield (mg-VSS/mg -COD)	Methane Yield (m^{3}CH4/kg COD$_{removed}$)	References
CP	UASB	90.00	31.0	-			Rico Gutierrez et al., 1991
SD	UASB Control Reactor	82-88					Leal et al., 2006
	Hydrolysed Reactor	90-91					Leal et al., 2006
CP	UASB	98-85	6.2-7.5				Gavala et al., 1999
RW	Intermittent UASB						Nadais et al., 2005
DID	UASB and AS*	98.9		1.08			Tawfik et al., 2008
SD	Continuous and intermittent UASB	64-78 (intermittent) 65-88 (continuous)					Nadais et al., 2005
DI	Two UASB in parallel	90	5.5	0.70			Passeggi et al., 2009
CW	UASB	> 90					Yan et al., 1989
WP	UASB	99-64.2		0.4-5			Hwang and Hansen, 1992
CP	UASB	90					Cammarota et al., 2001
SD	Two phase HUASB	97-99	10.7-19.2				Rajesh Banu et al., 2008
IC	AFBR I Two phase	65-90	1.1-6.6	8.11-1.13			Motta-Marques et al., 1990
	AFBR II Calcium Amended	75	1.5-9.4	6.67-1.11			Motta-Marques et al., 1990
	AFBR III Biopolymer system		1.5-9.4	6.67-1.11			Motta-Marques et al., 1990
	AFBR IV Control System	65-70	1.5-9.4	6.67-1.11			Motta-Marques et al., 1990

Similarly, anaerobic methods can also be used and their conditions and what are the treatment efficiencies are reported here. So, different types of reactor types UASB, hydrolyse reactor, intermittent USB. So, we can use different types of technologies for treatment of wastewater. And loading COD direction, HRT, etc., is reported here and that have been reported in the various literatures which are there.

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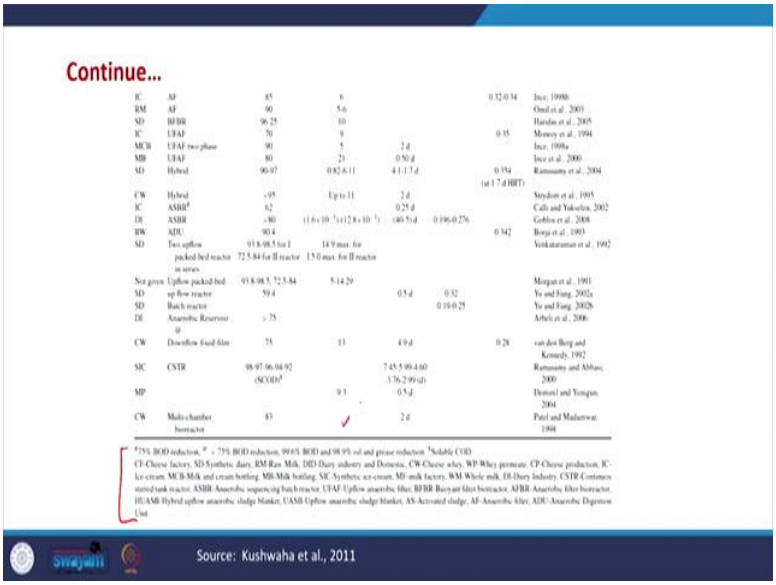

IC	AF	85	6			0.32-0.34	Ince, 1998b
RM	AF	90	5-6				Omil et al., 2003
SD	BFBR	96.25	10				Haridas et al., 2005
IC	UFAF	70	9			0.35	Mooney et al., 1994
MCB	UFAF two phase	90	5	2 d			Ince, 1998a
MB	UFAF	80	21	0.50 d			Ince et al., 2000
SD	Hybrid	90-97	0.82-6.11	4.1-1.7 d		0.354 (at 1.7 d HRT)	Ramasamy et al., 2004
CW	Hybrid	>95	Up to 11	2 d			Strydom et al., 1995
IC	ASBR[#]	62		0.25 d			Calli and Yuksekss, 2002
DI	ASBR	>80	(1.6×10^{-3})-(2.8×10^{-3})	(40.5) d	0.196-0.276		Gobles et al., 2008
RW	ADU	90.4				0.342	Borja et al., 1993
SD	Two upflow packed bed reactor in series	93.8-98.5 for I 72.5-84 for II reactor	14.9 max. for I 13.0 max. for II reactor				Venkatraman et al., 1992
Not given	Upflow packed-bed	93.8-98.5, 72.5-84	5-14.29				Morgan et al., 1991
SD	up flow reactor	59.4		0.5 d	0.32		Yu and Fang, 2002a
SD	Batch reactor				0.19-0.25		Yu and Fang, 2002b
DI	Anaerobic Reservior @	> 75					Arbeli et al., 2006
CW	Downflow fixed film	75	33	4.9 d		0.28	van den Berg and Kennedy, 1982
SIC	CSTR	98.97-96.94-92 (SCOD)[$]		7.45-5.99-4.60 -3.76-2.99 (d)			Ramasamy and Abbasi, 2000
MP			9.3	0.5 d			Demirel and Yenigun, 2004
CW	Multi-chamber bioreactor	83		2 d			Patel and Madamwar, 1998

[#]75% BOD reduction, [@] > 75% BOD reduction, 99.6% BOD and 98.9% oil and grease reduction [$]Soluble COD
CP-Cheese factory, SD-Synthetic dairy, RM-Raw Milk, DID-Dairy industry and Domestic, CW-Cheese whey, WP-Whey permeate, CP-Cheese production, IC-Ice cream, MCB-Milk and cream bottling, MB-Milk bottling, SIC-Synthetic ice-cream, MI-milk factory, WM-Whole milk, DI-Dairy Industry, CSTR-Continuous stirred tank reactor, ASBR-Anaerobic sequencing batch reactor, UFAF-Upflow anaerobic filter, BFBR-Buoyant filter bioreactor, AFBR-Anaerobic fiber bioreactor, HUASB-Hybrid upflow anaerobic sludge blanket, UASB-Upflow anaerobic sludge blanket, AS-Activated sludge, AF-Anaerobic filter, ADU-Anaerobic Digestion Unit

So, you can see the anaerobic methods are used more often as compared to aerobic method for treatment of dairy industry wastewaters of different types. So, all the abbreviations are given here at the bottom. So, through these different methods we can treat the dairy

wastewater via various methods, both anaerobic, aerobic we can see the treatment efficiency, we can see the operating parameters in terms of COD loading, HRT, etc.

And some literatures have reported the methane yielded sector also, that how much methane will be produced, how we can take care of the, we can further process the methane in the industry itself or otherwise. So, these are the different techniques.

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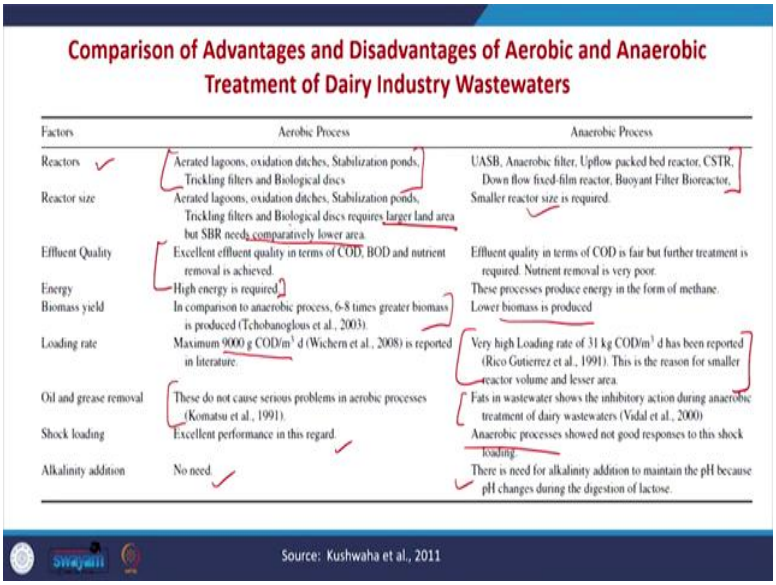

Now, comparison of advantages and disadvantages of aerobic and anaerobic treatment of dairy industry wastewater. So, if we have reactors of different types, you can see the aerobic processes, we can have different all these aerobic processes can be used. Similarly, we can use different type of anaerobic processes, the reactor size may be aerated lagoons. So, smaller reactor size is required for anaerobic process which is advantageous.

This aerated lagoons, oxidation ditches, stabilization Pond's, trickling filter, biological discs, they require larger land area. However, SBR will require comparatively lower area. Now, the effluent quality, that excellent effluent quality in terms of COD, BOD and nutrient is achieved if you are using aerobic process

However, the energy required is high. In comparison to anaerobic process 6 to 8 times greater biomass is also produced. The loading rate is up to maximum 9000 gram, whereas in this case that means 9 kg and here in the anaerobic case we can go up to 31 kg. So, that means loading here, if loading high we can go for anaerobic treatment. Here the energy requirement is also lesser because we are producing energy by our self, the biomass produce is also low.

So, that means anaerobic is generally preferable. Oil and gas removal they do not cause serious problems in the aerobic treatment, but in the anaerobic treatment fats in the wastewater, so inhibitory action. So that we have to take care of the fat beforehand. The shocked loading if it is there in the aerobic process, it can be taken care of but the very extremes shock loading cannot be taken care of in the anaerobic process.

Also alkalinity is not required to be added in the aerobic process. But it is required to be added in the anaerobic process, because we require to maintain in the certain pH range. So, these are the different advantages and disadvantages of aerobic or anaerobic treatment for dairy industry wastewater.

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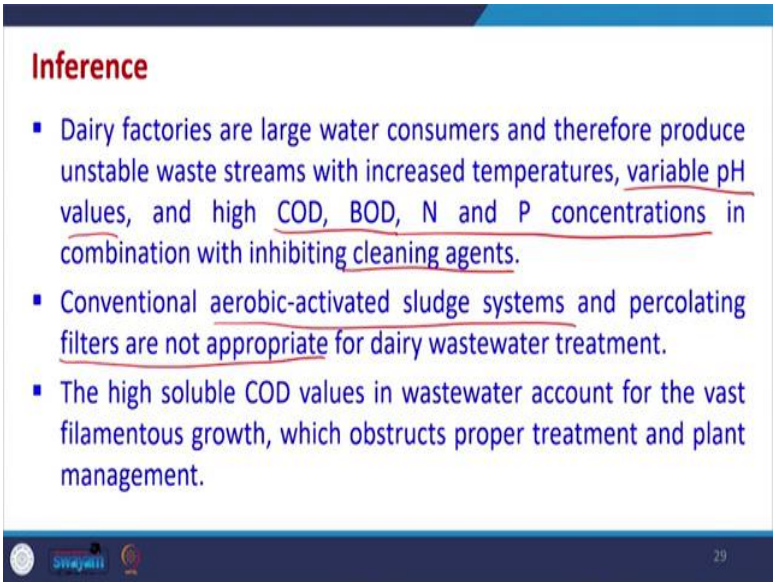

Overall, we can infer those dairy factories are large water consumers and they produce unstable waste streams with increased temperatures because the heating etc., also happens, steam is required during the pasteurization. So, that means temperature increase also. Also the wastewater discharge has variable pH values depending upon the processing.

Very high COD, BOD, nitrogen, and phosphorus concentration. So, all these parameters are high in combination with inhibiting cleaning agents are also there because surfactant, detergents are also there because they are used in cleaning. So, COD, BOD, nitrogen, and phosphorus are high.

Cleaning agents are also high. pH is variable and temperature may also be high because the steam is being used for pasteurization. So, conventional aerobic activities sludge systems

percolating filters are not appropriate for daily wastewater treatment. The high soluble COD values in the wastewater account for vast filamentous growth, which obstructs the proper treatment and plant management. So, we have to go for other techniques.

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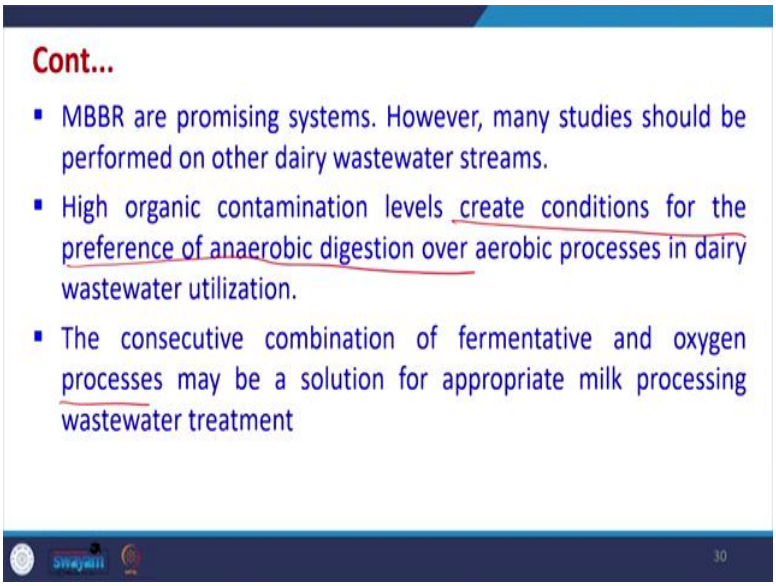

So, MBBR is like one of the promising systems. We can go for SBR also. However, for MBBR more studies are required because not many systems are reported yet. High organic contamination levels create conditions for the preference of anaerobic digestion over aerobic. So anaerobic processes or systems are preferred over aerobics processes in the daily wastewater utilization.

The combination of fermentative and oxygen processes may be a solution for appropriate milk processing wastewater treatment. So, we can use some combination of aerobic and anaerobic processes or anaerobic should be done first followed by aerobic. So, that we can treat the wastewater fully and achieve the minimum standards which have been prescribed by government of India or any other country, so that we can meet the requirement and we can treat their waste pattern in such a manner.

So, today we have studied the management of wastewater, which is generated in dairy industry. Dairy industry is highly variable with different characteristic, which also vary a lot. So, we have to check for what are the options that are there with respect to dairy wastewater treatment.

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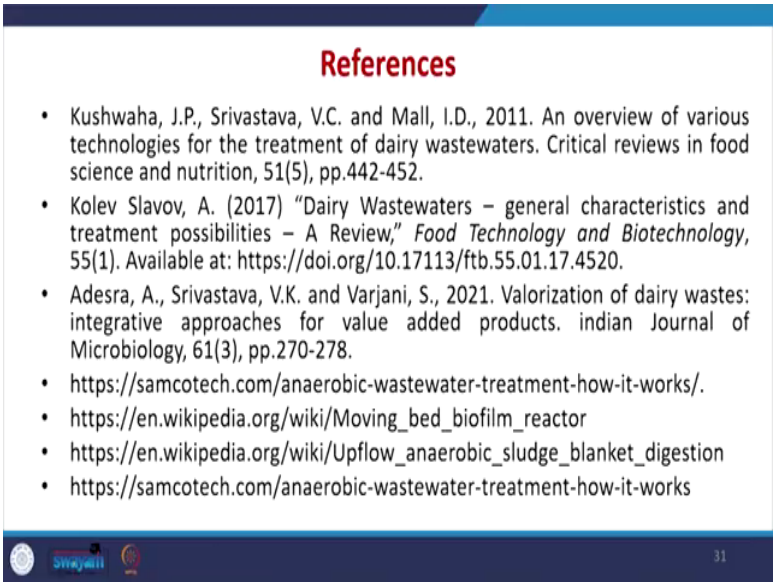

We have used all these references in the preparation of slides you can refer back to these references or further understanding the management of wastewater of waste diary industry. Thank you very much.