

*
**

pH

COD BOD

BOD

BOD

BOD

Archive of SID

// :

// :

*
**

pH ()

Archive of SID

()
(Maiorella et al., 1983)

(Maiorella et al., 1983)

()

: ()

()

(Singh and Nigam, 1995; Barnes, et al., 1984)

kwh

/	/	/	PH
			()COD
			()BOD
/	/		()
			()
			()
			()
			()
			()

(Maiorella et al., 1983)

(
(Maiorella et al., 1983)

: ()
(

(SCP)⁽¹⁾

/	()
/	()
	()
/	()
():	
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	
(µg/g):	
/	
/	

()

(Kumar & Viswanathan, 1991)

BOD

()

()

m³

/

/

/

)

(

oc

Kujala (Maiorella et al., 1983)

mg^l⁻¹

BOD

Ashbya Penicilium natatum

gossypil

(Sanai & Shayegan, 1979; Shayegan and Sanai, 1980)

()

()

()

()

()

()

:()

/ m³

			/		
/	/	/	/	/	
/	/	/	/	/	
					()

.(Kumar and Viswanathan, 1991)

)

(/ /

K₂O

pH

(m³)

/)

.(Sanai & Shayegan, 1980)

.(Monteiro, 1975)

(m³

.(Jackman, 1977)

(1966) Gundu-Rao

pH

.(Sastry & Mohanrao, 1964)

.(Gundu Rao, 1966)

.(Jackman, 1977)

/

mg/l COD

.(Maiorella et al., 1983)

()

.(Sanai and Shayegan, 1980)

cal/kg (Jackman, 1977) (Kumar and Viswanathan, 1991)

(K₂O)

(P₂O₅)

()

)

(

(Huffman, 1978)

°C

(Reich, 1945)

Reich .

(1964) Chakraborty

(Kumar and Viswanathan, 1991)

(Baffle)

% /

% /

°C

BOD COD

Gupta

%

BOD

(Kumar and Viswanathan, 1991)

(Sawyer, 1949)

BOD

()

Achromobacter Sarcina Actinophora Nocardia

(Maiorella et al., 1983)

Flavobacterium Zooglea Pseudomonas

pH

Anderson Sawyer

(Skogman, 1979)

BOD / kgBOD/m³.d :

(Sawyer, 1949) mg/l mg/l

COD (1973) Burnett Reis

mg/l BOD mg/l

(

/ / kg COD/ m³.d

COD /

(Burnett, 1973)

COD Reis Sant Ana

(Reis & Sant Ana, 1985)

BOD

BOD

(°C)

COD BOD
COD / /
(Singh and Nigam, 1995)

mg/l
mg/l
Elsworth Stander .)

(Barnes et al., 1984)
mg/l (2003)
COD SO₄ COD

COD
SRB
()

°C

(/) pH

Glanser (1985)

Ghosh (1985)

UASB

()

Cassell Wheatly

(1995)	Kida	()	kgCOD/m ³ .d
			(Chiesa & Manning 1986)
BOD		°C	Perez ()
		gTOC/l.d	°C
			kg/m ³ .d
			kg/m ³ .d
	Penicillium decumbens		
	Geotrichum candidum		
COD		°C	UASB
	(Fitzgibbon et al., 1995)		
	(1980) Chen		UASB
			()
		°C	
	BOD %	kg.COD/m ³ .d	
COD			()
		kg COD/m ³ .d	Fe Ni Co
			/ / mg/l
	()		(Sharma & Singh, 2001)
()		(1998)	Garcia
		()	
		kg/m ³	
			/ m/h
			/ /
Loutobacillus	Genus loutobacillus	Bacillus smithi	/ kgTOC/m ³ .d
Pseudomonas	Osillatoria	boryana hilgardii	TOC
()		fluorescence	

P. fluorescens

%

Aspergillus niger

Tremetes versicolor Corioulus Aspergillus fumigatus

.P.chryso sporium Geotrichum candidum

()

:()

		()				
Ohmomo et al., 1987					<i>Aspergillus fumigatus</i> No. G-2-6	
Miranda et al., 1996					<i>Aspergillus niger</i> (180)	
Toshiaki et al., (1987)			/		<i>Bacillus smithi</i>	
Fujita et al., 2000					<i>Corioulus hirsutus</i>	
Kumar et al., 1998			/		<i>C. versicolor</i>	
Aoshima et al., 1985					<i>C. versicolor</i> Ps ₄ a	
Fitzgibbon et al., 1995			/		<i>Geotrichum candidum</i>	
Kumar et al., 1997					Genus <i>Lactobacillus</i> (L-2)	
Ohmomo et al., 1988					<i>Lactobacillus hilgardii</i> (W-NS)	
Sirianuntapiboon et al., 1988					<i>Mycelia sterilia</i> D90	
Kalavathi et al., 2001	OH H ₂ O ₂) (<i>Oscillatorja boryana</i> BDU92181	
Kumar et al., 1998			/		<i>P. chryso sporium</i>	
Fahy et al., 1997					<i>P. chryso sporium</i>	
Dahiya et al., 2001					<i>Pseudomonas fluorescens</i>	
Benito et al., 1997					<i>T. versicolor</i>	

%

(%)

Aspergillus ()

()

(2004)

wh/l wh/l %
() (Barnes et al., 1984; Kida et al., 1995; Fitzgibbon et al., 1995)
% (2003)
(Mairella et al., 1983)

% /)
(
% (Pazouki et al., 2003)
Mairella (1983)

/ :

/ :

)

/ :

:

Archive of SID

(1999)

Vijayaragharan

(S.S)

mg/l COD % / NaCl

mA/cm²

COD

COD

pH

(Beltran et al., 2001; Alfafra et al., 2000)

COD

(psi)

/ kg/m³.d

UASB

kg COD/m³.d

COD

UASB UASB

COD

mg/l

UASB

()

Archive of SID

- 1- Single cell protein
- 2- Torula (*Candida utilis*)
- 3- Dilution is not a solution to pollution
- 4- Sulphate reducing bacteria
- 5- Down flow fluidized bed
- 6- Shochu

Aoshima, I. Tozawa, Y. Ohmomo, S. & Ueda, K. 1985. Production of decolorizing activity for molasses pigment by *coriolus versicolor* Ps4a. Agric. Biol. Chem. 49: 2041-2045.

Alfafa, C. G., Migo, V. P., Amarante, J. A., Dallo, R. F., Matsumura, M. 2000. Ozone treatment of distillery slop waste. Water. Sci. Technol. 42(3-4): 193-198.

-
- Fitzgibbon, F. J., Nigam, P., Singh, D., Marchant, R. 1995. Biological treatment of distillery waste for pollution-remediation. *J. Basic Microbiol.* 35(5): 293-301.
- Fujita, M., Ike, M., Kavagochi, Y., Miyata, N. 2000. Biotreatment of persistent substances using effective microorganisms. *Water Sci. Technol.* 42(12): 93-106.
- Garcia-Calderon, D. Buffiere, P. Moletta, R., Elmaleh, S. 1998. Anaerobic digestion of wine distillery wastewater in down-flow fluidized bed. *Water. Res.* 32(12): 3593-3600.
- Ghosh S. 1985. Methane production from industrial wastes by two-phase anaerobic digestion. *Water Res.* 19: 1083.
- Glanser, M. 1985. Fast fermentation of wastewater to methane. *Wiss Umwelt (Ger)* 1(42) Chem. Abstr. 103,56711.
- Gundu Rao, G. 1966. *Souvenir, All India Distillers Assoc.* 34.
- Huffman E. O. 1978. Fertilizers In: Grayson, E. (ed) *Kirk Othmer Encyclopedia of Chemical Technology.* 31 (John Wiley).
- Jackman, E. A. 1977. Distillery effluent treatment in the Brazilian national alcohol programme. *Chem. Eng.* 319: 319-239.
- Kalavathi, D. F., Uma, L., Subramanian, G. 2001. Degradation and metabolization of the pigment-melanoidin in distillery effluent by the marine
- Barnes, D., Forster, C. F., Hurudy, S. E. 1984. *Food and allied industries,* 46-55 (Pitman).
- Beltran, F. J., Garcia-Araya, J. F., Alvarez, P.M. 2001. pH Sequential ozonation of domestic and wine distillery wastewater. *Wat. Res.* 35(4): 429-936.
- Benito, G. G., Miranda, M. P., de la Santos, D. R. 1997. Decolorization of wastewater from alcoholic fermentation process with *Trametes versicolor*. *Biores. Technol.* 61: 33-37.
- Burnett, W. E. 1973. Rum distillery waste: Laboratory studies on aerobic treatment. *Water Sewage Works,* 120: 107-111.
- Chakrabarty, R. N. 1964. Potash recovery, A method of disposal of distillery wastes. p. 93 (Noyes Development Corporation, Pearl River, New York).
- Chen, C. S. 1980. Hawaii ethanol from molasses project final report, HNEL-80-03, Hawaii Natural Energy institute, University of Hawaii at Maroa.
- Chiesa, S. C. and Manning, Jr. J. F. 1986. Fermentation Industry. *J. Wat. Polln. Contl. Fed.* 58(6): 554-555.
- Dahiya, J. Singh, D. and Nigam, P. 2001. Decolorisation of molasses wastewater by cells of *Pseudomonas fluorescens* on porous cellulose carrier. *Biores Tech.* 78: 111-114.
- Fahy, V., FitzGibbon, F. J., McMullan, G., Singh, D., Marchant, R. 1997. Decolorization of molasses spent wash by *Phenacoccus chrysosporium*. *Biotechnol. Letts.* 19(1): 97-99.

-
- Miranda, M. P., Benti, G. G., Cristobal, N. S, Nieto, C. H. 1996. Color elimination from molasses wastewater by *Aspergillus*. *Biores. Technol.* 57: 229-235.
- Monteiro, C. E. 1975. Brazilian experience with the disposal of wastewater from the cane sugar and alcohol industry. *Proc. Biochem.* 10(11): 33-41.
- Ohmomo, S. Kaniko, Y., Apiboon, S. S., Somachi, P., Attasambu, P. 1987. Decolorization of molasses wastewater by a thermophilic strain, *Aspergillus fumigatus* G-2-6. *Agri. Biol. Chem.* 51(12): 3339-3346.
- Ohmomo, S., Daengsubha, W., Yoshikawa, H., Yui, M., Nozaki, Y., Nakajima, T., Nakamura, J. 1988. Screening of anaerobic bacteria with the ability to decolorize molasses melanoidin. *Agri. Biol. Chem.* 52(10): 2429-2435.
- Pazouki, M., Hussainnia, A., Banifathemi, M. 2003. Proceedings of Third National Biotechnology Conference. Central Composite Optimization of Important Parameters in Decolorizing Distillery Spent Wash Using a Locally Isolated *Aspergillus* Strain. 9-13 Sep. Mashad University, Mashad, Iran, pp 115-117.
- Pazouki, P., Hussainnia, A., Shayegan J.,d Banifathemi, M. S. 2003. Improving the activity of a locally isolated fungus in decolorization of pretreated distillery wastewater. *Iran. J. Chem. Eng.* (in press).
- Perez, M., Romero, L. L., Sales, D. 1998. Comparative Performance of high rate anaerobic thermophilic technologies treating industrial wastewater. *Wat. Res.*, 32(3): 559-564.
- cyanobacterium *Oscillatoria boryana* BDU 92181. *Enz. Microbiol. Technol.* 29: 246-251.
- Kida, K., Morimara, S. Abe, N., Sonoda, Y. 1995. Biological treatment of Shochu wastewater. *Proc. Biochem.* 30(2): 125-132.
- Kujala P., Hull, R., Engstrom, F., Jackman, E. A. 1976. Alcohol from molasses as a possible fuel. *Sugar Azucar.* 71(3): 28-39.
- Kumar, S., Viswanathan, L. 1991. Production of biomass, carbon dioxide, volatile acid and their interrelationship with decrease in chemical oxygen demand during distillery waste treatment by bacterial strains. *Enz. Microb. Technol.* 13: 179-187.
- Kumar, V., Wati, L., FitzGibbon, F., Nigam, P., Banat, I. M. & Singh, D. 1997. Bioremediation and decolorization of anaerobically digested distillery spent wash. *Biotechnol. Letts.* 19(4): 311-313.
- Kumar, V., Wati, L., Nigam, P., Barat, I. M., Yadav, S., Singh, D., Marchant, R. 1998. Decolorization and biodegradation of anaerobically digested sugar cane molasses spent wash effluent by methanation plants by white rot fungi. *Proc. Biochem.* 33:83-88.
- Maiorella B. L., Blanch, H. W., Wilke, C. R. 1983. Distillery effluent treatment and by-product recovery. *Proc. Biochem.* 18: 5-12.
- Mehdizadeh, H. and Shayegan, J. 2003. The effect of sulfate concentration on COD removal and sludge granulation in ASB reactors. *J. Eng.* 16(1): 1-10.

-
- Shayegan, V., Sanai, M. 1980. Land disposal of wastewater from a beet sugar factory and its effect on soil. *J. of Environl. Polln. (Series B)* 1(1): 61-70.
- Singh, D, and Nigam, P. 1995. Treatment and disposal of distillery effluents in India. In: M. Moo-Young et al. (eds). *Environl. Biotech: Principles and Applications*. 735-750.
- Sirantapiboon, S. P., Somachai, P., Ohmomo, S., Atthasampunna, P. 1988. Screening of filamentous fungi having the ability to decolorize molasses pigment. *Agr. Biol. Chem.* 52(2): 387-392.
- Skogman, H. 1979. Effluent treatment of molasses based fermentation wastes. *Proc. Biochem.* 14 (1): 5-11.
- Vijayaraghavan K., Ramanujam, T. K., Balasubramanian, N. 1999. In situ hypochlorous acid generation for the treatment of distillery spent wash. *Ind. Eng. Chem. Res.* 38: 2264-2267.
- Reich, G. T. 1945. Production of carbon and potash from molasses distiller's stillage. *Trans. Am. Ins. Chem. Eng.* 41: 233-252.
- Reis L. & Sant Ana, G. C. 1985. Aerobic treatment of concentrated wastewater In a submerged bed reactor. *Water. Res.* 19: 1341.
- Sanai, M. & Shayegan, J. 1979. Water pollution abatement through reuse of municipal wastewater in agricultural system. *J. of Environl. Polln* 10(2): 119-127.
- Sanai, M., Shayegan, J. 1980. Field experiemnts on application of treated municipal wastewater to vegetated land. *J. Water Polln. Contl.* 79 (1): 126-135.
- Sastry, C. A., Hohanrao, G. J. 1964. Ethyl alcohol production technique, P 88 (Noyes Der. Corp. Pearl. River, New York).
- Sawyer, C. N., Anderson, E. J. 1949. Anaerobic treatment of rum waste. *Water Sewage Works.* 14:112-114.
- Sharma, J. & Singh, R. 2001. Effect of nutrients supplementation on anaerobic sludge development and activity for ttreating distillery effluent. *Biores. Technol.* 79: 203-206.
- Shayegan, J. Pazouki, M., Afshari, A. 2004. Continous decolorization of anaerobically distillery wastewater. *Proc. Biochem. J.* (in press).