Filamentous organism bulking in nutrient removal activated sludge systems. Paper 4: System configurations and operating conditions to develop low F/M filament bulking sludges at laboratory-scale

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Abstract

intermittent aeration conditions (30% aerobic, 70% anoxic) in single-reactor continuously fed completely mixed systems sustain the growth of the low food to micro-organism ratio (F/M, long sludge age) filaments, *Microthrix parvicella* and Types 0092.0041, 0675,0914 and 1851, to give diluted sludge volume index (DS VI) values of between 200 and 5(X)ml/g. Changing from intermittent to continuous aeration (DO, 2 to 4 mg *O/l)* ameliorates the low F/M filament bulking to give DSVI values as low as 60 ml/g in the absence of a selector effect.

List of symbols

AVSS	=	active heterotrophic organism VSS concentration (mg *AVSS/l)*
CFCM	=	continuously fed completely mixed
CFCM/SEL	=	continuously fed completely mixed with selectors
COD	=	chemical oxygen demand
CTRL	=	control
d	=	day
DO	=	dissolved oxygen (mg *O/l)*
DSVI	=	diluted sludge volume index
EXP	=	experimental
F/M	=	food to micro-organism ratio
h	=	hour
IAND	=	intermittent aeration nitrification-denitriftcation
IFFD	=	intermittently fed fill and draw
m	=	meter
min	=	minute
MLSS	=	mixed liquor suspended solids
MLVSS	=	mixed liquor volatile suspended solids
MUCT	=	modified UCT
N	=	nitrogen
ND	=	nitrification-demtrification
NUR	=	nitrate utilisation rate as mg NO_3-N/(lh) or mg NO_3N/(g AVSS-h)
OUR	=	oxygen utilisation rate in mg O/(l-h) or mg O/{g AVSS-h)
P	=	phosphorus
RBCOD	=	readily biodegradable COD
s	=	second
TKN	=	total Kjeldahl nitrogen
um	=	micro (10^{-6}) meters

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Introduction

The main objective of the investigation described by Still et al. (1996) of this series has been to evaluate the stimulation of the selector effect in activated sludge and its role in control of bulking by low F/M filaments. With regard to the stimulation of the selector effect it was found that the alternating feed-starve conditions imposed by intermittent feeding to single reactor systems (IFFD) or continuously fed completely mixed systems, operated under aerobic or anoxic-aerobic conditions and incorporating aerobic selector reactors (CFCM/SEL), stimulate in the sludge a selector effect, i.e. a high readily biodegradable COD (RBCOD) uptake rate: This rate is 2 to 3 times higher than in systems which do not have alternating feed-starve conditions, such as continuously fed completely mixed systems. If the conditions are aerobic, the high RBCOD uptake rate gives rise to an associated high (initial) OUR under batch conditions and if the conditions are anoxic, it gives rise to an associated high (initial) NUR under batch conditions. It was found that the selector effect can be stimulated or eliminated in a sludge over a period of less than a sludge age in long sludge age systems by introducing or removing alternating feed-starve conditions respectively. The observations regarding the stimulation of a selector effect in a sludge subjected to alternating feed-starve conditions was in agreement with research reported in the literature.

With regard to the role of the selector effect in controlling bulking by low F/M filaments, this could not be investigated because none of the laboratory systems bulked with low F/M filaments. Indeed, the laboratory-scale systems, when started up with bulking sludges with low F/M filaments (DSVI >250 ml/g and containing usually in varying proportions, type 0092, *Microthrix parvicella,0914, 0675,*1851 and 0041 filaments) from long sludge age full-scale nitrogen removal (anoxic-aerobic) plants, invariably ceased bulking (DSVI < 80 *mlg)* within a month from start up, irrespective of whether or not the system incorporated alternating feed-starve conditions. Apparently bulking by low F/M filaments was ameliorated under fully aerobic or alternating anoxic (1 h) - aerobic (3 h) conditions whether or not a selector effect was present. That the low F/M filaments did not proliferate in the