OPTIMIZATION OF GAS TRANSFER COEFFICIENT (k_{La}) BASED ON VARIATION OF MICRO BUBBLE TECHNOLOGY OPERATION TIME ON GREEN ROOF RUNOFF WATER

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ABSTRACT

ABDILLAH LUTHFI. Optimization of Gas Transfer Coefficient (k_{La}) Based on Variation of Micro Bubble Technology Operation Time on Green Roof Runoff Water. Supervised by YUDI CHADIRIN dan ALLEN KURNIAWAN.

Green roof is solutions to deal with the reduction of green open areas as recharge water areas. However, green roofs still produce runoff that has low DO values that do not meet water quality standards. Micro bubbles have been proven to be effective in increasing the dissolved oxygen (DO) concentration in water. To increase the effective value and efficiency of micro bubbles, the value of the gas transfer coefficient (k_{La}) must be known. In this research, 4 green roof models with *Chlorophytum comosum*, *Arachis pintoi* and *Portulaca grandiflora* vegetation and unvegetated media will be tested to find the highest and lowest k_{La} values with 4 variations of treatment time (30, 45, 60 and 75 min). The highest k_{La} is obtained by *Portulaca grandiflora* runoff water with fibrous and fine root morphology in 45 min treatment with a k_{La} value of 0.493/min. The lowest k_{La} is obtained by unvegetated media runoff water with the fastest treatment (30 min) which is 0.141/min. With temperature conditions of 20°C-35°C and target DO concentration of 6 mg/L, the designed scenario of the highest k_{La} value of micro bubble treatment for 2.26-4.44 min, while the treatment of the lowest k_{La} value for 8.49-21.54 min.

Keywords: green roof, dissolved oxygen, gas transfer coefficient, micro bubble.

ABSTRAK

ABDILLAH LUTHFI. *Optimasi Koefisien Transfer Gas* (k_{La}) *berdasarkan Variasi Waktu Operasi Teknologi Gelembung Mikro pada Air Limpasan Atap Hijau*. Dibimbing oleh YUDI CHADIRIN dan ALLEN KURNIAWAN.

Atap hijau menjadi salah satu solusi untuk menghadapi pengurangan area terbuka hijau yang berperan sebagai area tangkapan air. Namun atap hijau masih menghasilkan limpasan yang memiliki nilai oksigen terlarut (DO) rendah sehingga belum memenuhi standar baku mutu air. Gelembung mikro telah terbukti efektif meningkatkan konsentrasi DO dalam air. Untuk meningkatkan efektivitas dan efisiensi dari gelembung mikro, nilai koefisien transfer gas (k_{La}) harus diketahui. Pada penelitian ini, 4 model atap hijau yang bervegetasi Chlorophytum comosum, Arachis pintoi dan Portulaca grandiflora serta tanpa vegetasi akan diuji untuk mencari nilai k_{La} tertinggi dan terendah dengan 4 variasi waktu perlakuan (30, 45, 60 dan 75 menit). Nilai k_{La} tertinggi didapatkan oleh air limpasan Portulaca grandiflora dengan morfologi akar serabut dan halus pada perlakuan 45 menit dengan nilai k_{La} 0,493/menit, sedangkan nilai k_{La} terendah didapatkan air limpasan media tanpa tanaman dengan perlakuan paling cepat (30 menit) yaitu 0,141/menit. Dengan kondisi suhu 20°C hingga 35°C dan konsentrasi DO yang dituju 6 mg/L, skenario yang terancang dari nilai k_{La} tertinggi berupa perlakuan gelembung mikro selama 2,26 menit hingga 4,44 menit, sedangkan perlakuan gelembung mikro dari nilai k_{La} terendah selama 8,49 menit hingga 21,54 menit.

Kata kunci: atap hijau, oksigen terlarut, koefisien transfer gas, gelembung mikro.

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PREFACE

The author prays the praise and gratitude to Allah SWT, who has given the author health and blessing to properly complete the undergraduate thesis titled "Optimization of Gas Transfer Coefficient (k_{La}) Based on Variation of Micro Bubble Technology Operation Time on Green Roof Runoff Water" promptly. The thesis was created and submitted to meet the requirement for a bachelor's degree in the Department of Civil and Environmental Engineering, IPB University.

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The author has contrived the thesis as best as possible, but the author is also aware of many imperfections in both content and grammar. Consequently, the author welcomes any suggestions and constructive corrections to improve. The author wishes this thesis would be helpful in enriching readers' knowledge.

Bogor, July 2024

Abdillah Luthfi

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α	= Significance (0.05)
C^*	= Saturated gas concentration, (mg/L)
C_L	= Gas concentration in water sample at the time of treatment (mg/L)
$\bar{D}$	= Average difference between data existing and data modelling
GCR	= Gas consumption rate
GTR	= Gas transfer rate
k_d	= Gas consumption rate constant, (min^{-1})
k_{La}	= Gas transfer coefficient, (min^{-1})
$k_{La(T)}$	= Value of k_{La} at treatment, (min^{-1})
k_{La20}	= Value of k_{La} at 20°C, (min^{-1})
n	= Total sample
T	= Temperature of sample (°C)
t	= Time (minute)
t_{crit}	= Critical t value (from t value table)
t_{stat}	= Statistic t value
var	= Variance
SD	= Standard deviation
x_i	= Existing measurement values
$\bar{x_i}$	= Modelling prediction result value