We first have eq. (*): $\frac{dc_F}{dt} = k_1 \cdot c_w - (k_2 + k_m + k_g) \cdot c_F$

We then start a new equation for $\frac{dm_F}{dt}$ with $m_F = c_F \cdot V_F$ <u>and</u> both, $c_F$ and $V_F$, as time-dependent variables:

$$\frac{dm_F}{dt} = \frac{d(c_F \cdot V_F)}{dt} = c_F \cdot \frac{dV_F}{dt} + V_F \cdot \frac{dc_F}{dt} \quad \text{(product rule)}$$

Now we insert eq. (*) for $\frac{dc_F}{dt}$ here:

$$\frac{dm_F}{dt} = k_1 \cdot c_w \cdot V_F - (k_2 + k_m + k_g) \cdot c_F \cdot V_F + c_F \cdot \frac{dV_F}{dt} \cdot \overbrace{\frac{V_F}{V_F}}^{=1}$$

with $k_g = \frac{\frac{dV_F}{dt}}{V_F}$, we obtain:

$$\frac{dm_F}{dt} = k_1 \cdot \frac{V_F}{V_w} \cdot m_w - (k_2 + k_m) \cdot m_F \cancel{- k_g \cdot c_F \cdot V_F} \cancel{+ k_g \cdot c_F \cdot V_F}$$

$$= k_1 \frac{V_F}{V_w} \cdot m_w - (k_2 + k_m) \cdot m_F$$

$$= k_1' \, m_w - k_2' \cdot m_F \quad \text{with } k_2' = k_2 + k_m$$

This is the correct version of eq. (**)

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on p. 7 of my notes: no $D_g$ or $D_g = 0$ ?