

peptidoglycan crosslinking



$$\begin{aligned} m_{\text{amino acid}} &\approx 110 \text{ Da} \\ m_{\text{murein sugar}} &\approx 250 \text{ Da} \end{aligned}$$

BNID: 104877

average amino acid
molecular weight

average molecular weight
GlcNac and NAMA

$$m_{\text{subunit}} \approx 5 \times m_{\text{amino acid}} + 2 \times m_{\text{murein sugar}} \approx 10^3 \text{ Da} \approx 2 \times 10^{-6} \text{ fg}$$

$$m_{\text{pg}} \approx 0.03 \times m_{\text{dry}} \approx 10 \text{ fg}$$

BNID: 101936

PG mass per cell

$$N_{\text{subunits}} \approx \frac{m_{\text{pg}}}{m_{\text{subunit}}} \approx \frac{10 \text{ fg}}{\frac{\text{cell}}{2 \times 10^{-6} \text{ fg}}} \approx 5 \times 10^6 \text{ subunits / cell}$$

$$\Phi_{\text{crosslinked}} \approx 20\% \quad \text{Vollmer et al. 2008; Rogers et al. 1980}$$

fraction of crosslinked PG

$$r_{\text{transpeptidase}} \approx 2 \text{ crosslinks / sec} \quad \text{Catherwood et al. 2020}$$

crosslinking rate

$$\begin{aligned} N_{\text{transpeptidases}} &\approx \frac{N_{\text{subunits}} \times \Phi_{\text{crosslinked}}}{r_{\text{transpeptidase}} \times t_{\text{division}}} \approx \frac{5 \times 10^6 \frac{\text{subunits}}{\text{cell}} \times 0.2}{2 \frac{\text{crosslinks}}{\text{sec}} \times 5000 \frac{\text{sec}}{\text{cell}}} \\ &\approx 100 \text{ transpeptidases} \end{aligned}$$

number of transpeptidase
complexes