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# The depth of cure of composite resin in connection of the applied dose of light

**Language:** English

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## Introduction

What correlation exists between the dose of light and the depth of cure of composite resin?
Can the depth of cure be increased by enhancement of the dose of light?

## Objectives

Development of a theoretical model for the correlation between the applied amount of light and the depth of cure.

## Material and Methods

The hardening depths were determined by means of ISO 4049 after radiation of various samples of composite resins of different manufacturers und shades with a LED polymerization light (Celalux, VOCO with lambda= 460 ± 20 nm) of 4,44 J/cm² (5 sec.), 9,10 J/cm² (10 sec.), 18,2 J/cm² (20 sec.) and 36,4 J/cm² (40 sec.).

## Results

The depth of cure d increases with rising dose of light D and decreases with ascending opacity of the composite resin. The increase of d is nonlinear and decreases with rising time of radiation (Fig. 1). A constant growth of depth of cure can be measured with a duplication of exposure time (Fig. 2).

The depth of cure can be described in close approximation (r> 0,9968) by the equation **d = b× lnD + a**

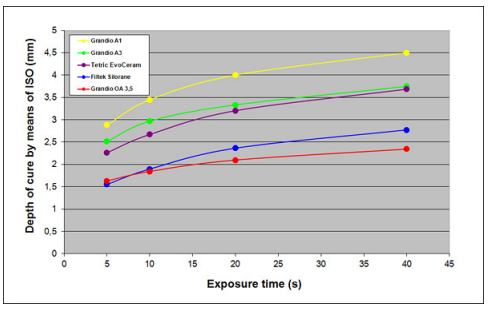


Fig. 1: Depth of cure versus exposure time

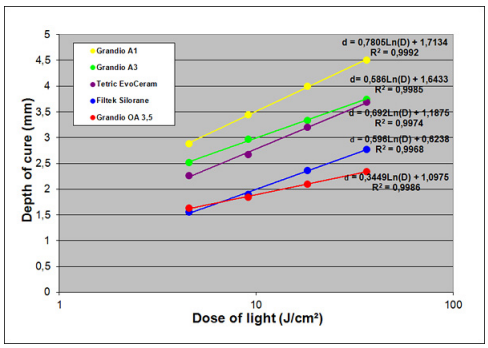


Fig. 2: Depth of cure as a function of dose of light

## Conclusions

For the in the depth d applied and for hardening necessary dose of light Dmin applies according to Lambert-Beer-Law:

$D_{min} = D \bullet e^{-\alpha d}$ (D = irradiated dose of light on surface; α = absorption constant)

Solve the equation for $d = \frac{1}{\alpha} \ln\left(\frac{1}{D_{min}}\right) + \frac{1}{\alpha} \ln D$

Introduction of $A = \frac{1}{\alpha}\left(\ln\left(\frac{1}{D_{min} \bullet k}\right)\right)$ and $B = \frac{\ln 2}{\alpha}$ (with k = 0,1 cm²/J)

results in $d = A + B\frac{\ln(D \bullet k)}{\ln 2}$

Thereby represents:

A: Depth of cure in mm, achieved with 10 J÷cm² dose of light
B: Increase of depth of cure in mm with duplication of the dose of light

Clinical relevance

- Several thin layers (layering technique) require a shorter exposure time than one thick layer (block technique).
- With voluminous restorations: additional hardening in depths (d> 1,5×A) is nearly impossible.
- It is proposed that the manufacturers of the composite resins publish the for their products applicable constants A and B and calibrate the scales of the light curing units in J÷cm ².

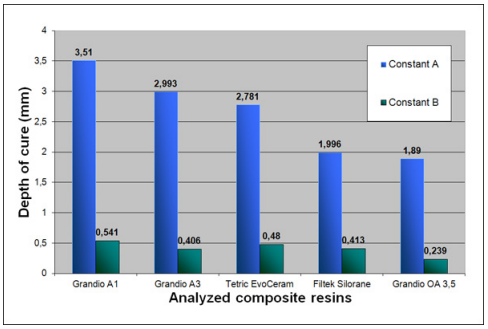


Fig. 3: Constants A and B for the analyzed composite resins using the LED light curing unit Celalux (Fa. VOCO)

*This Poster was submitted by Dr. Britta Leubecher.*

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**Poster Faksimile:**

# The depth of cure of composite resin in connection of the applied dose of light

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**Problem**
What correlation exists between the dose of light and the depth of cure of composite resin?
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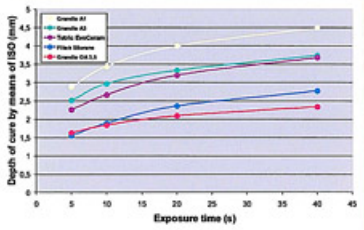


Fig.1 Depth of cure versus exposure time

A constant growth of depth of cure can be measured with a duplication of exposure time (Fig.2).

The depth of cure can be described in close approximation (r > 0,9968) by the equation

$$d = b \cdot \ln D + a$$

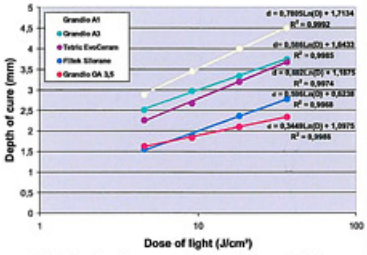


Fig.2 Depth of cure as a function of dose of light

**Discussion**
For the in the depth d applied and for hardening necessary dose of light $D_{min}$ applies according to Lambert-Beer-Law:

$D_{min} = D \cdot e^{-\alpha d}$ (D = irradiated dose of light on surface; α = absorption constant)

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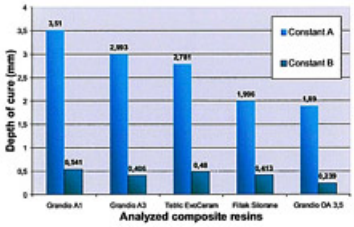


Fig.3 Constants A and B for the analyzed composite resins using the LED light curing unit Celalux (Fa. VOCO)

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