



OXYGEN INHIBITION LAYER IN RESIN BASED MATERIALS

PRESENTED BY : DR. GEETA ASTHANA

CONTENTS

~~1. INTRODUCTION~~

~~2. DEFINITION~~

~~3. FORMATION~~

~~4. COMPOSITION AND CHARACTERISTICS~~

~~5. FACTORS AFFECTING OXYGEN INHIBITION OF RESIN BASED MATERIALS~~

~~6. CLINICAL SIGNIFICANCE OF OXYGEN INHIBITION LAYER~~

~~➤ INTERFACIAL BOND STRENGTH~~

~~➤ COLOUR STABILITY~~

~~➤ REPAIR~~

7. METHODS TO CONTROL OXYGEN INHIBITION LAYER

8. MATERIAL ADVANCES TO REDUCE OXYGEN INHIBITION LAYER

8. CONCLUSION

9. REFERENCES

oxygen in x OIL in x role of ox x Influence: x Evaluatio: x Oxygen in x nitrogen x oxyegn in x oxygen in x

BeeCut

onedental.co.in/Product/ProductDetails?productId=186

Apps Gmail YouTube Maps News Translate

OIL

ENDODONTICS

DR. NIRANJAN VATKAR

00:03

One dental

Windows Search

09:39 11-12-2020 ENG 6

Light curing in dentistry and clinical implications: a literature review

Frederick Allen RUEGGEBERG^(a)
Marcelo GIANNINI^(b)
Cesar Augusto Galvão ARRAIS^(c)
Richard Bengt Thomas PRICE^(d)

Abstract: Contemporary dentistry literally cannot be performed without use of resin-based restorative materials. With the success of bonding resin materials to tooth structures, an even wider scope of clinical applications has arisen for these lines of products. Understanding of the basic events occurring in any dental polymerization mechanism, regardless of the mode of activating the process, will allow clinicians to both better appreciate the

Temperature rise within the pulp chamber caused by the light curing unit (LCU)

The first *in vitro* analyses evaluated the temperature rise within the pulp chamber when extracted teeth were exposed to light emitted from QTH, Plasma Arc, and first generation LED units.^{98,108,109,100,11,112}

Overall, the use of QTH and Plasma Arc lights caused higher temperature rise within the pulp chamber in comparison to the first generation LED evaluated in those studies.^{98,108,109,110} At that time, such differences in the temperature rise were attributed to the differences in the curing light outputs, because compared to the QTH light, no light was emitted by the LED curing


with lower radiant exposure values. In addition, LCU design has been shown to influence the pulp temperature rise during light exposure. For instance, LED units with pulse output technology such as LEDemetron II¹²¹ help reducing pulp temperature rise.¹²² In the other hand, LED units with diodes placed on the light tip may cause a higher pulp temperature rise.¹²²

Despite the attempts to develop reliable and predictable methodologies to reproduce the *in vivo* condition, a wide range from 1.5 to 23.2 °C in the *in vitro* pulp temperature rise during exposure to light emitted by such LCUs has been reported.^{97,100,101,103,114,123,124,125} Such a discrepancy among results might be related to the



Article

Light Transmittance and Polymerization of Bulk-Fill Composite Materials Doped with Bioactive Micro-Fillers

Phoebe Dieckmann ¹, Dirk Mohn ^{1,2}, Matthias Zehnder ¹ , Thomas Attin ¹ and Tobias T. Tauböck ^{1,*}

been launched to simplify and accelerate the restoration process by allowing thick composite layers up to 4 or even 5 mm to be photo-polymerized in one step [21,22]. Studies showed an increased depth of cure of bulk-fill resin composites compared to conventional composites which has been mainly attributed to their higher translucency and, therefore, favorable light transmittance [23,24]. Different concepts have been pursued to increase the depth of cure. In some bulk-fill resin composites, the filler content was reduced or the filler size increased which lowers the interface area between fillers and resin matrix and, thus, decreases light scattering [23]. Other bulk-fill resin composites contain optimized germanium-based photo-initiators with a higher light reactivity than classic camphorquinone to ensure adequate polymerization of thick composite layers [23,25].

To date, it is unknown whether bioactive glass 45S5 can be incorporated as filler into bulk fill

Stability of radicals in cured composite materials

P. Burtscher

Abstract. During the radical polymerization of dental composites, the monomers polymerize to form a three-dimensional network containing remaining double bonds and free radicals. At 37 °C, these radicals decompose logarithmically with a half-life of 2-5 d. In this study, the half-life of radicals in a light-cured inlay composite was determined at different temperatures, and the influence of different fillers and filler amounts on the stability of these radicals in light-cured experimental composites was investigated. There is a strong logarithmic relationship between the half-life of the radicals and temperature. At a constant temperature, the half-life of radicals depends on the type of filler, the filler fraction, and the filler surface treatment. The stability of radicals determines to a great extent the adhesion of one composite to another, such as the adhesion of a luting cement to an inlay material.

RESULTS

The investigation of the half-life of free radicals in the light-cured commercial composite material at different storage temperatures gave the following results (Table 2). Combining all this data in one graph, it can be easily seen that there is a logarithmic relationship between half-life and storage temperature (Fig 3)

TABLE 2: HALF-LIFE OF CURED COMMERCIAL COMPOSITE MATERIAL AT DIFFERENT TEMPERATURES

Temperature in °C	Half-Life in hours
-23	10320
6	2400
23	150
37	53
50	4.80
70	1.68
93	0.24

TABLE 3: INFLUENCE OF DIFFERENT FILLERS ON THE STABILITY OF RADICALS IN CURED EXPERIMENTAL COMPOSITES AT 37°C

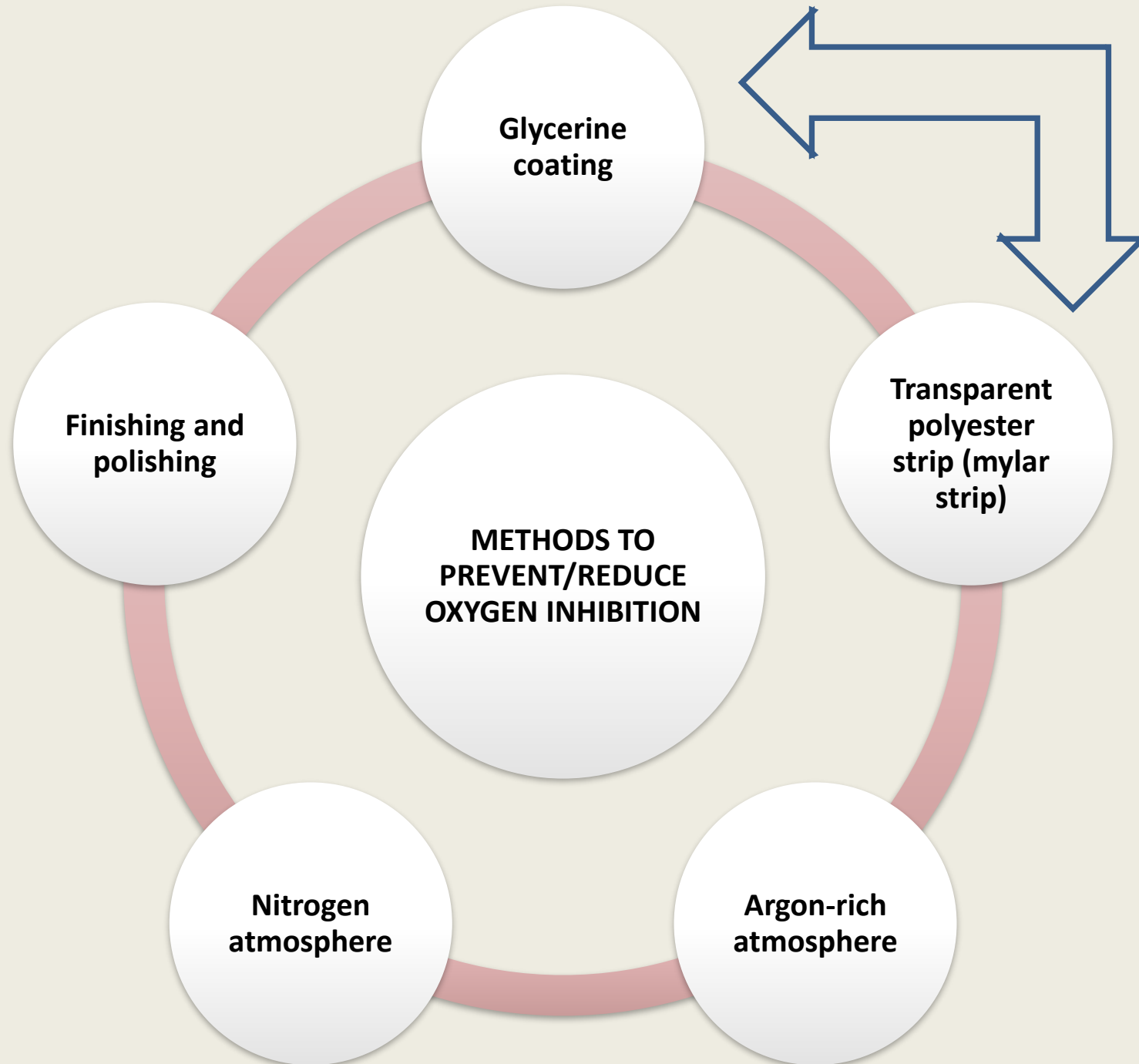
Composite	Type and amount of filler	Half-Life in hours*
A	77% Glass s.c. 10% Fumed silica s.c.	51.5
B	70% Glass s.c. 10% Fumed silica s.c.	67.4
C	60% Glass s.c. 10% Fumed silica s.c.	84.7
D	60% Glass s.c.	118.0
E	60% YbF ₃	63.5
F	60% Fumed silica s.c.	44.4
G	70% Glass n.s.c. 10% Fumed silica n.s.c.	33.2

*All half-lives are statistically different (p<0.05)

radicals (Composites A,B,C).

The surface of a silica filler can be modified with a silane coupling agent, *i.e.* 3-Methacryloxypropyltrimethoxysilane. This coating allows a good bonding of the matrix resin to the filler. The silanizing agent has a remarkable influence on the half-life of radicals (Composites B and G). Uncoated surfaces accelerate the decay of radicals much more than silane-treated surfaces. Silanization of the filler was performed by mixing the filler with 0.5-5 % of 3-Methacryloxypropyltrimethoxysilane (h.200 090).

BARRIER METHODS



BARRIER METHOD

The use of a mylar strip, or application of glycerin are effective ways to reduce formation of oxygen inhibition layer



Using mylar strip is the most effective method (park and lee)



Mylar strip completely blocks any contact of restorative material with air while in the case of glycerin, some amount of oxygen present in the glycerin can contribute to the formation of oil.

The glycerin is then rinsed off prior to finishing and polishing.

It must be noted that this oxygen-inhibited layer can also form on the margins of indirect restorations that have been bonded with resin cements, **so it is advisable to also use glycerin on the margins of these restorations – especially if you are not routinely finishing back the margins.**



FINISHING AND POLISHING

Finishing and polishing is essential for esthetics and longevity of the restoration. While finishing is gross contouring to obtain a proper anatomy ;polishing reduces the roughness and scratches produced by finishing and produces a proper lustre to the restoration

OIL affects the prognosis of the restoration-reducing its surface hardness,wear resistance and marginal adaptation ;thus it is necessary to eliminate it

The occlusal adjustment, and finishing and polishing cant completely eliminate the oil

8th International Conference Interdisciplinarity in Engineering, INTER-ENG 2014, 9-10 October
2014, Tirgu-Mures, Romania

Effect of curing, finishing and polishing techniques on microhardness of composite restorative materials

Gabriela Strnad^{a*}, Monika Kovacs^b, Edina Andras^b, Liana Beresescu^b

^a*"Petru Maior" University, Faculty of Engineering, str. N. Iorga, nr.1, TirguMures, 540088, Romania*

^b*University of Medicine and Pharmacy of Tirgu Mures, Faculty of Dental Medicine, str. Gh. Marinescu, nr. 38, Tirgu Mures, 540000, Romania*

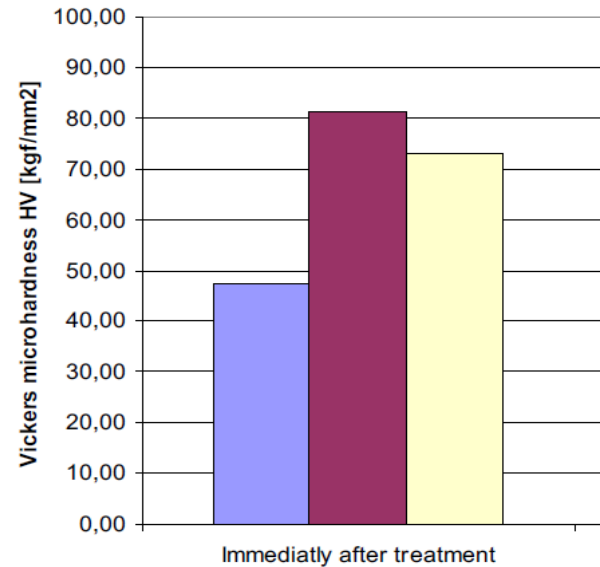
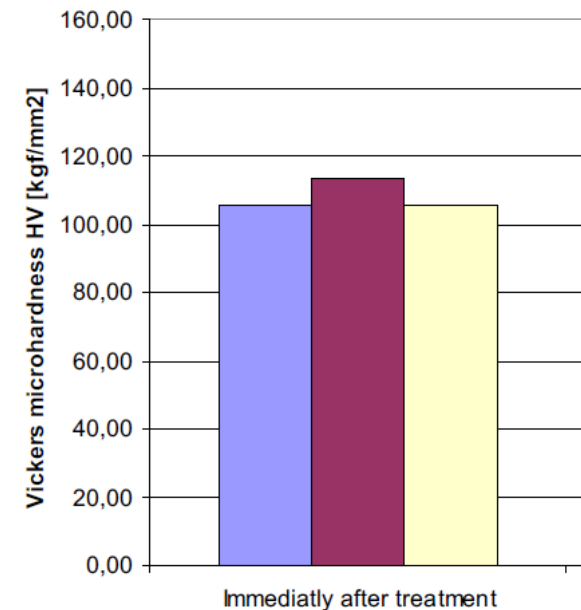


Fig. 1. Surface hardness of composite restorative material prepared by cu



After polishing

CLINICAL SIGNIFICANCE

In practice,as long as finishing polishing procedures occur, it is not important to protect the restorative material during the curing stage

However at the same time it has to kept in mind that the oxygen inhibition layer can't be totally removed and may remain in the deep pits and fissures of the surface even after polishing.

Therefore,using mylar strip for proximal cavities,or application of glycerin for occlusal surfaces and hard to reach cavities is recommended during photopolymerization

Effect of glycerin on the surface hardness of composites after curing

Hyun-Hee Park¹, In-Bog Lee^{2*}

¹Department of Dentistry, Seoul National U.

²Department of Conservative Dentistry, Seoul National University School

For the unpolished specimens measured right after curing, the use of a Mylar strip was most effective in preventing OIL formation, and the application of glycerin before curing was the second most effective method. When additional curing with glycerin applied to specimens already cured in air, the surface

Among the procedures tested in this study, the most effective method for reducing OIL formation was polishing after light curing. Polishing results in a higher surface hardness than that produced when a matrix is used,¹³ is effective in preventing discoloration,¹⁷ and is advantageous in achieving a satisfactory surface and marginal adaptation.¹⁸ Clinically,



BISCOVER LV LIQUID POLISH

- BisCover LV is a low-viscosity, light-cured resin **formulation** used to seal all your composite restorations while leaving a smooth polished/glazed surface.
- BISCO was the first to offer a universal intraoral and extraoral brush-on aesthetic sealant and glaze,
- Due to its **unique proprietary chemistry, BisCover LV can be cured using an LED, PAC or halogen curing light in 30 seconds without a sticky oxygen-inhibited layer.**
- BisCover LV is resistant to staining and colour shifting resulting in more aesthetic results.

SILORANE BASED COMPOSITES

Recently dimethacrylate-based monomers have been replaced with silorane-based systems

This monomer system combines an **oxirane ring** (which opens during polymerization) and **siloxane** (that increases the hydrophobicity of the resin composite).

The most important difference between the two monomer systems is that dimethacrylates are cured with a free radical, whereas silorane-based composites are cured via cationic polymerization

The curing reaction in siloranes is a photoinitiated cationic ring-opening polymerization reaction of epoxy monomers with an iodonium salt, an electron donor, and camphorquinone (CQ) as the photoinitiators.

Irradiation of photoinitiator



Fragmentation of iodonium salt and subsequently an acidic cation is released



The cation protonates the oxirane groups of the monomer



Begins cationic polymerization by opening the oxirane ring



ELSEVIER



Short communication

Incremental layers bonding of silorane composite: The initial bonding properties

A. Tezvergil-Mutluay*, L.V.J. Lassila, P.K. Vallittu

Department of Prosthetic Dentistry and Biomaterials Science, Institute of Dentistry, University of Turku, Lemminkäisenkatu 2, FIN-20520 Turku, Finland

tion of the silorane molecule is cationic polymerization reaction where no oxygen inhibition layer exists on the surface of the composite after polymerization in air. Oxygen inhibition layer of the free radical polymerized dimethacrylate-based composite. Within the limitations of the current study this hypothesis was not accepted as the statistical evaluation showed no significant difference. However, the mean shear bond strength obtained with silorane was lower, and the percent of adhesive failures (25%) were higher compared to dimethacrylate-based composite. Moreover, the shear bond strength between the successive layers of silorane composites showed a decrease in shear bond strength and an increase in the percent of adhesive failures when the time of placement between the successive layers increased. This suggests that as the chemical reactivity decays over time,¹¹ the bond strength could be affected.



ELSEVIER

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.intl.elsevierhealth.com/journals/dema



Oxygen inhibition and incremental layer bond strengths of resin composites

Essam S. Shawkat, Adrian C. Shortall, Owen Addison, William M. Palin*

Biomaterials Unit, School of Dentistry, College of Medical and Dental Sciences, University of Birmingham, St Chads Queensway, Birmingham B4 6NN, UK

thickness. The OIL surface layer thickness for the commercial methacrylate-based KBC specimens cured in air were 19.2 ± 6.3 and $13.8 \pm 5.3 \mu\text{m}$, respectively and $9.0 \pm 6.6 \mu\text{m}$ for Silorane. No test material exhibited a measurable OIL thickness polymerized in the nitrogen atmosphere.

Significance. From the current findings it may be concluded that incremental bond strength is not wholly reliant on surface inhibition since no differences in bond strength following immediate placement were observed between air and nitrogen atmosphere for any experimental or commercial material. For large restorations requiring multiple increments which are placed on fresh material, the bond strength between successive layers of Silorane should be no different to conventional methacrylate materials. Repair and bonding to aged Silorane restorations may be more problematic as inferior incremental bond strengths ensued when addition was delayed.

© 2009 Academy of Dental Materials. Published by Elsevier Ltd. All rights reserved.

CONCLUSION

Since resin composite materials are a material of choice for restoring teeth and resin cements are commonly being used to bond indirect restorations, it is important understand the formation of oxygen inhibition layer in these materials and incorporate methods to reduce or inhibit its formation as well removal for long term survival of such restorations

REFERENCES

1. Suh BI. Oxygen-inhibited layer in adhesion dentistry. *Journal of Esthetic and Restorative Dentistry*. 2004 Sep;16(5):316-23
2. Bijelic-Donova J, Garoushi S, Lassila LV, Vallittu PK. Oxygen inhibition layer of composite resins: effects of layer thickness and surface layer treatment on the interlayer bond strength. *European journal of oral sciences*. 2015 Feb;123(1):53-60.
3. Shawkat ES, Shortall AC, Addison O, Palin WM. Oxygen inhibition and incremental layer bond strengths of resin composites. *Dental Materials*. 2009 Nov 1;25(11):1338-46.
4. Truffier-Boutry D, Place E, Devaux J, Leloup G (2003). Interfacial layer characterization in dental composite. *Journal of Oral Rehabilitation* 30(1):74-77
5. Rueggeberg FA, Dlugokinski M, Ergle JW (1999). Minimizing patients' exposure to uncured components in a dental sealant. *Journal of the American Dental Association* 130(12):1751-1757

6. Burtscher P (1993). Stability of radicals in cured composite materials. *Dental Materials* 9(4):218-221.
7. Carvalho RM PJ, Yoshiyama M, Pashley DH (1996). A review of polymerization contraction: the influence of stress development versus stress relief. *Operative Dentistry* 21(1):17-24.
8. Weinmann W, Thalacker C, Guggenberger R (2005). Siloranes in dental composites. *Dental Materials* 21(1):68-74.
9. Rueggeberg FA, Margeson DH (1990). The effect of oxygen inhibition on an unfilled/filled composite system. *Journal of Dental Research* 69(10):1652-1658.
10. Gauthier MA, Stangel I, Ellis TH, Zhu XX (2005). Oxygen Inhibition in Dental Resins. *Journal of Dental Research* 84(8):725-729.
11. Dall'Oca S, Papacchini, F, Goracci, C, Cury, AH, Suh, BI, Tay, FR, Polimeni, A, Ferrari, M (2007). Effect of oxygen inhibition on composite repair strength over time. *Journal of Biomedical Materials Research Part B: Applied Biomaterials* 81B(2):493-498.
12. Eliades GC, Caputo AA (1989). The strength of layering technique in visible light-cured composites. *The Journal of Prosthetic Dentistry* 61(1):31-38.

13. Park HH, Lee IB. Effect of glycerin on the surface hardness of composites after curing. Journal of Korean Academy of Conservative Dentistry. 2011 Nov 1;36(6):483-9.

14. TEZVERGIL-MUTLUAY A, LASSILA LVJ, VALLITTU PK. Incremental layers bonding of silorane composite: the initial bonding properties. J Dent 2008; 36: 560–563.

15. Bijelic-Donova J, Garoushi S, Lassila LV, Vallittu PK. Oxygen inhibition layer of composite resins: effects of layer thickness and surface layer treatment on the interlayer bond strength. European journal of oral sciences. 2015 Feb;123(1):53-60.

THANK YOU