

Dedication

I dedicate this work to
My family, who care much
about my education
And to those whom I love

Acknowledgement

Praise to Allah who gave me health and patience to accomplish this work.

Thanks to **prof. Nafia Abdellteef**, is to given credit for his efforts and encouragement in the preparation of this work.

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Abstract

One of the difficult duties in chemical industrial units is the determination of the level of liquid for real – time monitoring. Determination of this parameter is useful in process control loop. Hence present study is devoted for this purpose by employing microbend based optical fiber sensor.

In optical fibers the microbending is considered as a one of the unwanted properties in optical communications due to its effect on attenuating and distorting the transmitted signals. Nevertheless, it's possible to exploit this property in modulating the light intensity and hence using the fiber as liquid level sensor.

In this work, in order to continuously monitor liquid level in petroleum and chemical industries, an optical fiber sensor based on microbend effect was designed and manufactured. The system is consist of a sensor that is composed of a microbend modulator, sensing fiber, emitting / detecting devices, in addition to liquid container unit, and an electronic circuit was used to control the liquid level.

Four threaded aluminum blocks with different spatial period, and one flat, are used to generate microbending in a multimode step index fiber. These blocks (one flat and another threaded for each case) cross the fiber and pressed by the liquid container unit, liquid pressure is converted into small displacement of portable block, and then the sensing fiber is bent and the through light intensity is reduced. By detecting the output light power, liquid level can be obtained according to the exerted pressure. A relation between the resulting laser output in term of voltage and load in term of liquid height, and spatial period (number of teeth) are obtained in each case. So the conclusion is that the mechanism of microbending can be used in optical fiber to produce a liquid level sensor, and then control of that level.

Using pressure measurement to determine liquid level is particularly useful for applications with foaming or bubbling liquid, where other level measurement technologies have difficulties.

The results show that the laser technique is both accurate and immediate.

Test results show that this sensor is suited for dangerous applications of liquid level measurement especially in fields where electrical isolation and / or electromagnetic interference (EMI) resistance are strictly required.

الخلاصة

أحد المشاكل فى الوحدات الصناعية الكيمائية ، هو التحديد الفورى لمستوى السائل . ان تحديد هذا المعامل مهم للسيطرة عليه فى حلقة التحكم. ومن هنا فإن الدراسة الحالية قد كُرسَتْ لهذا الغرض بإستخدام الإنحناء الدقيق لليف البصري.

تعتبر الإنحناءات الدقيقة إحدى الصفات غير المرغوبة فى الاتصالات الضوئية بسبب تأثيرها فى توهين وتشويش الإشارة المرسلة فى الألياف البصرية . الا أن هذه الصفة يمكن ان تكون مفيدة اذا ما تمت السيطرة عليها ، واستخدامها كآلية لتضمين الشده الضوئية فى سبيل إعتادها كمجس لمعرفة مستوى السائل.

فى هذا البحث تم تصميم منظومة تعمل كمجساً للقياس المستمر لمستوى السائل ومن تمّ التحكم فى هذا المستوى فى مجال الصناعات البترولية والكيمائية باستخدام آلية الانحناء الدقيق ، والمنظومة مكونه من مرسل ومستقبل وليف بصرى وألواح المونيوم وانا به سائل ثم دائرة التحكم.

استخدمت أربع ألواح المونيوم مسننة مسببه للانحناء الدقيق بقيم مختلفة للمسافات بين الأسنان ولوح خامس مستوٍ لإحداث الانحناءات المايكروية لليف البصري وذلك بوضع الليف بين

لوحين (أحدهما مستو " ثابت " و الآخر مسنن " متغير ") والضغط عليه
بالإناء الذى يحوي السائل ، ضغط السائل يتحول إلى إزاحة صغيرة
للوح المتحرك تتسبب في انحناء الليف البصري ونقصان الشدة
الضوئية التي يحويها. ثم باكتشاف الضوء الخارج من الليف يتم
التعرف على مستوى السائل وفقاً للضغط المطبق. العلاقة بين ضوء
الليزر الخارج من الليف وإرتفاع السائل، والمسافة بين الأسنان (عدد
الأسنان) سُجلت لأي حالة.
النتائج توضح إمكانية استخدام آلية الإنحناء الدقيق فى الألياف البصرية
لعمل مجس لقياس مستوى السائل ومن تم التحكم فيه وذلك بقياس
التوهين الناتج فى الإشارة الخارجة من الليف.
إستخدام قياس الضغط الهيدروستاتيكي لتحديد مستوى السائل مفيد
فى التطبيقات التى تحتوى علي سائل ذو رغوه و فقائيع، بينما يصعب
ذلك علي الطرق الأخرى.
أظهرت النتائج أن القياس بإستخدام تقنية الليزر تعطى نتائج دقيقة و
سريعة. أيضاً النتائج تُظهر أن هذا المجس يناسب قياس مستوى
السائل فى البيئات الخطرة وخاصة التى تتطلب عزل كهربائى او
تتطلب مقاومة التداخل الكهرومغناطيسي.

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