# Spirometric Measurements among Workers of Tasluja Cement Factory.

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**Abstract**

*Prolonged exposure to cement is hazardous and studies abroad showed that repeated and prolonged exposure to cement dust causes respiratory impairment.This study aimed at assessing the respiratory function among workers of Tasloja cement factory which is one of the biggest cement factories in the region, For this purpose a group of 139 cement workers with a group of 68 control subjects were enrolled in this study. The cement workers group was divided into directly exposed and indirectly exposed. Both groups were examined by spirometry .Spirometric examination included the determination of $FEV_1$, FVC, $FEV_1$/FVC% and PEF, at the same time their height& weight were determined. There was a significant decrease in peak expiratory flow(PEF) among the exposed group. Other spirometric values showed non-significant decrease. The decrease in spirometric measurements was directly proportional to the duration of employment .*

**Keywords:** Portland cement, spirometry, Chronic Obstructive Pulmonary Disease( COPD).

## Introduction:

The reconstruction in Iraq is developing with the peaceful security situation in the north (Kurdistan). This has encouraged an increase rate of construction resulting in an increased demand for cement which requires employment of more workers in cement factories.

Environmental and occupational respiratory diseases account for a significant portion of preventable illnesses. Occupational lung disease is the number one work-related illness in the United States based on the frequency, severity, and preventability of diseases [1].

Cement is one of the most widely used construction materials. Anyone who uses cement or mixtures containing it e.g. mortar and concrete or is responsible for managing or supervising its use should be aware that it may be a hazard to health and that safe working practices must be used to minimize the risk [2].

Portland cement contains mineral dusts; the manufacturing process of cement involves several stages in which dust is emitted, resulting in workers exposure. Cement dust is a particularly alkaline and irritant dust, and might therefore be considered to pose a greater risk of respiratory tract damage than many other poorly soluble dusts (generically often referred to as “low toxicity dusts”) [3].

The main occupational hazard during cement processing is dust, however high ambient temperature, radiant heat and high noise levels are also common hazards [4]. In the short term, exposure to high levels of cement dust irritates the nose and throat and causes difficulty with breathing [2]. Bronchoconstriction occurs during the work shift for the cement workers who are exposed to relatively high dust concentrations producing changes in pulmonary function during a work shift in exposed workers. Reductions in $FEV_1$, $FEV_1$/FVC ratio and FEF in the range of

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25% to 75% have been noticed by some studies [5]

The reduced $FEV_1$% in cement factory workers may be due to reflex bronchospasm triggered by inhaled irritant cement dust or as a result of type 1 hypersensitivity reaction [6].

Repeated and prolonged inhalation of cement dust is associated with chronic respiratory symptoms and impairment of lung function [7,8]. The severity of the impairment of respiratory function has been shown to depend on years of exposure [6]

Exposure to various dusts , chemicals , vapors, and fumes in the workplace is an attributing factor for many people with COPD. In one report, estimates showed that 19.2% of COPD cases in the USA were attributable to work exposures[9]

Occupational airborne exposures have been suggested to be associated with COPD independent of smoking, particularly when sufficiently intense and/or prolonged [10].

Although a complete pulmonary function test provides the most accurate objective assessment of lung impairment, Spirometry is the preferred test for the diagnosis of COPD because it can obtain adequate information in a cost-effective manner [11] and as is shown in Figure (1).

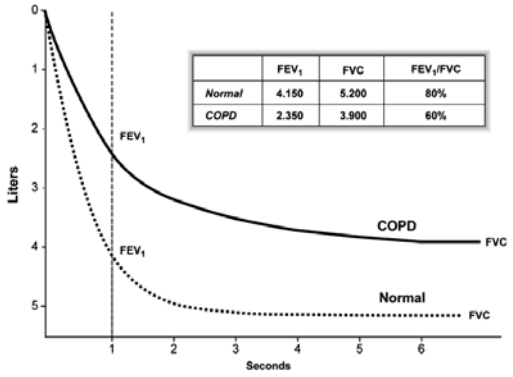


**Figure: 1: Normal spirogram and spirogram typical of patients with mild to moderate COPD[11]**

The predicted reference values for FVC, $FEV_1$ and FEF vary with the height, sex, and age of the subject. The values increase with increasing height; they are lower in females than in males of similar height and age; and decline progressively in the adult with advancing age [12].

The aim of this study is to investigate the effect of cement dust on pulmonary function in workers of Tasluja cement factory.

## Subjects and Methods

This is a retrospective cohort study carried out on workers of Tasloja cement factory (TCF), and a control group from the university during April to August 2007.

One hundred and thirty nine exposed workers from the factory and 68 controls(non- exposed) were enrolled in this study.

The exposed workers were divided into directly exposed groups based on the sections in which they were working in the operation department for most of their duration of work in the factory and indirectly exposed working in the administrative & maintenance departments.

Spirometric measurement was performed by using a flow sensing portable Spirometry, Vitalograph compact II Spirometry (Buckingham England) model 6600. The procedure and equipment were explained to each subject, and then the test was carried out. Both exposed and non-exposed groups were examined.The subjects were seated, then asked to breathe in fully, seal their lips around the mouthpiece ( nose closed with nose clip),air was forced out of the chest as hard and fast as they can . Exhalation must continue until no more air can be exhaled and must be at least 6 seconds [13]. At least three attempts were done, the best of the three was chosen and the

highest FVC and $FEV_1$ were retained for analysis [11].

Forced Vital Capacity (FVC), Forced Expiratory Volume in first second ($FEV_1$), $FEV_1$\FVC ratio and Peak Expiratory Flow (PEF) were measured. The per cent predicted $FEV_1$, which is the most widely accepted index of the severity of airway obstruction with the percentage of predicted FVC were also calculated.

The measured indices were converted to BTPS (Body Temp.ambient Pressure Saturated with water vapour) and expressed as percentage of predicted according to the European respiratory society as we have no standards for our society [11].

The height and weight of the subjects were measured without shoes.

For statistical analysis ANOVA and unpaired T-test were used to examine the difference between the groups. P-values equal or less than 0.05 was considered statistically significant& P- value of less than 0.01 was considered highly significant.

**Results**

There was no significant difference in the age and body mass index BMI between the cement workers ( exposed)& the comparison group( non exposed). The exposed workers had lower PEF; the difference with non-exposed group were highly significant. The other spirometric values in spite of being lower in the exposed workers did not show significant differences (Table 1) All the spirometric values were lower in the directly exposed workers but the differences were not statistically significant as shown in Table2. This table also shows that the obstructive impairment ($FEV_1$\FVC% below 70%) was more in the directly exposed workers . This difference ,however, is statistically insignificant.

**Table.1. Spirometric values in exposed and non-exposed cases**

| Parameter | Non exposed group N=68 | Exposed group N=139 | p-value |
|---|---|---|---|
| age (years) | 36±8.735 | 42.63 ±9.7 | 0.054 |
| BMI | 28.38±4.3 | 27.59±3.9 | 0.259 |
| $FEV_1$\FVC % | 83.07±5.5 | 79.71±5.5 | 0.97 |
| $FEV_1$%pred | 119.07±19 | 113.14±15 | 0.052 |
| FVC%pred | 117.97±15 | 117.24±16 | 0.644 |
| PEF | 587.69±152 | 518.65±113 | 0.002 |

**Table .2. Spirometric values in workers directly and indirectly exposed to dust**

| Spirometry value | Directly exposed n=97 | Indirectly exposed n=42 | P value |
|---|---|---|---|
| Age | 42.6 ±9.3 | 42.6±10.8 | 0.125 |
| BMI | 27 ±3.9 | 28±3.9 | 0.765 |
| Duration of employment | 10.8±7.9 | 12±8.9 | 0.063 |
| $FEV_1$\FVC% | 79 ±5 | 80.4±5 | 0.564 |
| $FEV_1$% pred | 112 ±16 | 114.7±12.6 | 0.052 |
| FVC% pred | 116±17 | 118±13 | 0.202 |
| $FEV_1$\FVC % < 70% | 3.1% | 2.4% | 0.649 |

**Table 3: Spirometric Measurements according to the duration of employment in the factory**

| Spirometric measures | Below 10yrs (n =78) % | 10- 19 yrs (n =20) % | 20y - 30yrs (n =41) % | P value |
|---|---|---|---|---|
| $FEV_1$\FVC% | 80±5 | 79±3 | 78±6 | 0.495 |
| $FEV_1$% pred | 114±15 | 111±18 | 111±13 | 0.492 |
| FVC % | 119±16 | 114±17 | 114±14 | 0.349 |
| PEF | 518±120 | 530±116 | 513±101 | 0.748 |
| $FEV_1$\FVC% below 70% | 0% | 0% | 9.7% | Non-applicable |

## Discussion

From the spirometry measurements, PEF was significantly lower in the cement workers. This is in agreement with the finding of Meo et al[14] and Mwaiselage et al[15], who noticed significantly decreased post shift PEF in cement workers although we could not compare the pre and post shift PEF in our work as the test was performed within their shift. A study in Saudi Arabia also concluded decrease in post shift PEF in cement workers[5].The significantly decreased PEF in the exposed group suggests that bronchoconstriction had occurred during the work shift for the cement workers, who were exposed to relatively high dust concentrations. The other spirometry measurements were higher in the non-exposed than the exposed group, $FEV_1$\FVC% was 83±5 in the non-exposed versus 79.7±5 in the exposed, $FEV_1$ % of the predicted value were 119±19 versus 113±15, FVC% predicted 118±15 versus 117±16 but were statistically insignificant.

Among the cement workers the spirometry results were lower for the workers who were directly exposed to cement dust, but the differences were statistically not significant.This could be explained by the fact that both groups are exposed to dust but at different levels, and that workers in one group worked for many years in the other group as we classified their work place according to the last place worked in for most of their employment duration.

The spirometric values of $FEV_1$\FVC%, $FEV_1$%, FVC% of the predicted values decreased with increased duration of exposure but were not statistically significant.

Here it is valuable to mention the importance of duration of exposure, this is consistant with the results of a recent cross-sectional study in a Tanzanian cement factory concluding that thirty years exposure to average total inhalable dust levels of $10mg.m^{-3}$ would lead to marked deficits in $FEV_1$ and FVC [15].

Low values for $FEV_1$ and $FEV_1$/FVC% suggest airway obstruction and the threshold traditionally used as lower limit of normal is 80% of predicted $FEV_1$ and a $FEV_1$/FVC% of 70% [11].

## Conclusion

The decreased peak expiratory flow in exposed workers is most probably the direct effect of the cement dust exposure & this effect is directly proportional to the duration of exposure .Although we didn't have dust level measurements but workers in the operative department are more affected.As far as the functional capacity of the lungs can be determined during exercise, we recommend stress pulmonary function test to be performed to detect sub clinical respiratory compromises not detected by resting spirometry in our study.

## References

1. American lung association.Occupational lung disease fact sheet.**2005** Available from( http://www.lungusa.org/site/pp.asp).(accessed Dec **2007**)
2. Health and safety at work inspectorate.Information Document.Cement Issue.**2002.** Availablefrom(http://www.gov.im/lib/docs/dlge/enviro/cement.pdf).(accessedDec 2007)
3. Meo SA. Health hazards of cement dust.*Saudi Med J*.**,2004,**25(9),1153-9.
4. Masoud N , Alireza C. Work related respiratory symptoms and ventillatory disorders among employers of a cement industry in shiraz. *Iran ,J Occup health*,**2007,**49,273-8.
5. Ali BA, Ballal SG, Albar AA, Ahmed HO. Post shift changes in pulmonary function in a cement factory in eastern Saudi Arabia.*Occup Med***,1998,**45(8),519-22.
6. Alakija W,Iyawe VI, Jarikre LN, Chiwuzie JC. Ventilatory function of workers oat Okpella cement factory in Nigeria.*West Afr J Med***,1990,**9,187-92.
7. Noor H, Yap CL,Zolkepli O, Faridah M. Effects of exposure to dust on lung function of cement factory workers.*Med J Malaysia***,2000**,55(1),51-7.
8. Al Neami YI, Gomes J, LIoyd OL .Respiratory illnesses and ventillatory function among workers at a cement factory in rapidly developing country.*J Occup Med***,2001**,51(6),367-73.
9. Hnizdo E, Sullivan PA,Bang KM, Wagner G. Association between chronic obstructive pulmonary disease and employment by industry and occupation in the US population: a study of data from the third national health and nutrition examination survey.*Am J Epidemiol***,2002**,156,738-46.
10. Romain A, Pauwels A, Sonia B, Bartolome R. Global strategy for the diagnosis,management and prevention of chronic obstructive pulmonary disease. *Am J Respir Crit Care Med***,2001,**163,1256-76.
11. GOLD( Global Initiative for Chronic Obstructive Lung Disease). Pocket guide to COPD Diagnosis,Management,and prevention. A guide for health care professionals.Revised December **2006**. Available from ( http:// www.goldcopd.org).(accessed Dec **2007**)
12. Noe Zamel, Murray D ,William A, Speir J. Statement on spirometry a report of the section on respiratory pathophysiology.*Chest***,1983**,83,547-50.
13. Barreiro TJ , Perillo I. An approach to interpreting spirometry. *Am fam Physician*,**2004,**69(5),1107-14.
14. Meo SA,Azeem MA, Ghori MG, Subhan MMF. Lung function and surface elecrromyography of intercostals muscles in cement mill workers.*Int J Occup Med Environ Health*,**2002**,15(3),279-87.
15. Mwaiselage J, Bratveit M, Moen B. Cement dust exposure and ventilatory function impairement. An exposure-Response study. *JOE*,.**2004,**46(7),658-67.

# پێوانە کانی هە ناسە دان لە لای کریکارانی کارکەی جیمە نتۆی تاسلوجە

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## پوختە

ئەوە زانراو و ئاشکرایە کە دووچاربوونی دوورودرێژ بۆ ماددەی چیمەنتۆ بریتیەیە لە مەترسیەك لەسەر تەندروستی مرۆڤ, و تویژینەوە جیهانیەکان دەریا نخستووە کە دووچاربوونی بەردەوام و دوورودرێژ بۆ ماددەی چیمەنتۆ بەشێوەیەکی سیلبی کاردەکاتە سەر کۆنەندامی هەناسە لەگەڵ پەیدابوونی نیشانەکانی نەخۆشیەکانی نەم کۆنەندامە. ئامانج لەم تویژینەوەیە ئەوەیە کە باری تەندروستی هەناسەدانی کریکارانی کارگەی چیمەنتۆی تاسلوجە هەڵسەنگێنرێت, کە یەکێکە لە گەورەترین کارگەکانی چیمەنتۆ لەم ناوچەیەدا, و هەروەها لێکۆڵینەوە بکرێت لە کاریگەریی ماددەی چیمەنتۆ لەسەر ئەو کریکارانە. بۆ ئەم مەبەستە کۆمەڵێك لە کریکارانی ئەو کارگەیە هەڵبژێردران کە ژمارەیان ١٣٩ کەس بوو لەگەڵ 68 کەسی تر لە دەرەوەی کارگەکە وەك گرووپێکی کۆنترۆڵ, ئەو کۆمەڵەی کریکارانی کارگەکە دابەشکران بۆ دوو بەش: ئەو بەشەی راستەوخۆ دوچاری چیمەنتۆ دەبن, و بەشێکی تر کە ناڕاستەوخۆ دوچاری چیمەنتۆ دەبن. هەردوو گروپەکە پشکنران بەهۆی ئامێری هەناسە پێوەوە. پشکنینەکان بەهۆی ئامێری هەناسە پێوەوە بریتی بوو لەمانە : دیاری کردنی قەبارەی هەناسەدانەوەی بەزۆر لە چرکەی یەکەمدا, توانای زیندەگی بەزۆر, ڕێژەی سەدی قەبارەی هەناسەدانەوەی بەزۆر بۆ توانای زیندەگی بەزۆر لەگەڵ دیاریکردنی لوتکەی دەرپەڕینی هەناسەدانەوە, لەهەمان کاتیشدا پێوانەی درێژی و کێش و پەستانی خوێنیشیان بۆ کرا. سەبارەت بە پشکنین بە ئامێری هەناسە پێو, کەمێیەکی ئاشکرا و گرنگ لەرووی ژمێریاریێیەوە هەبوو لە لوتکەی دەرپەڕینی هەناسەداندا لەلای ئەو گرووپەی کە دووچاری تەپوتۆزی چیمەنتۆ بوون, بەڵام گرنگی کەمی پێوانە هەناسەییەکانی تری هەمان گرووپ کەمتربوو وە لەرووی ژمێریاریشەوە گرنگ نەبوو لەگەڵ بوونێکی زۆری نیشانە هەناسەییەکان تێیاندا. لێرەوە دەگەینە ئەو ڕاستیەی کە دووچاربوون بۆ تەپوتۆزی چیمەنتۆ دەبێتەهۆی دروست بوونی چەند نیشانەیەکی گرنگی سیستمی هەناسەدان, لەگەڵ ڕوودانی کەمی و نوقسانیەکی ئاشکرا و گرنگ لە لوتکەی دەرپەڕینی هەناسەداندا لەلای ئەو کەسانەی کە لەم بارودۆخەدا کاردەکەن بۆ چەند ساڵێکی دوورودرێژ.

# قیاسات التنفس للعاملین في معمل اسمنت طاسلوجه

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## الخلاصه

من المعروف ان التعرض الطویل لمادة الاسمنت یشکل خطورة صحیة, واوضحت الدراسات العالمیة ان التعرض المتکرر و الطویل لمادة الاسمنت یؤثر سلبا على جهاز التنفس مع ظهور اعراض تنفسیة. تهدف هذة الدراسة الى تقییم الوضع الصحي التنفسي للعاملین في معمل اسمنت طاسلوجة و الذي یعد من اکبر معامل الاسمنت في هذة المنطقة و دراسة تاثیر مادة الاسمنت على هؤلاء العاملین. لهذا الغرض اختیرت مجموعة مکونة من ١٣٩ شخص من العاملین في المعمل بالاضافة الى٦٨ شخص من خارج المعمل کمجموعة ضابطة. قسمت مجموعة العاملین في المعمل الى قسمین: القسم المعرض بصورة مباشرة للاسمنت والقسم المعرض بصورة غیر مباشرة للاسمنت. فحصت المجموعتین بجهاز مقیاس التنفس اشتمل الفحص بمقیاس التنفس على تحدید حجم الزفیر القسري في الثانیة الاولى, السعة الحیویة القسریة, النسبة المئویة لحجم الزفیر القسري الى السعة الحیویة القسریة مع تحدید ذروة التدفق الزفیري. في الوقت ذاته تم قیاس الطول و الوزن بالنسبة للفحص بمقیاس التنفس کان هناك نقص واضح و مهم احصائیا في ذروة التدفق الزفیري عند المجموعة المعرضة لغبار الاسمنت, بینما کان النقص في القیاسات التنفسیة الاخرى عند نفس المجموعة بدرجة اقل وغیر مهمة احصائیا من هذا نستنتج ان التعرض لغبار الاسمنت یؤدي الى نقص واضح ومهم في ذروة التدفق الزفیري عند الذین یعملون في هذا الجو لمدة سنین طویلة.

وەرگیراوە لە ٢٠٠٨/٦/١٧ دا , و پەسەند کرا لە ٢٠٠٩/٦/٦ دا

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