

# RECORDED DUST CONDITIONS AND POSSIBLE NEW SAMPLING STRATEGIES ON SOUTH AFRICAN GOLD MINES

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This paper refers only to dust sampling in controlled South African mines of Group A, which are all large and relatively deep gold mines in the Witwatersrand Geological System.

At present about 340,000 persons are exposed to dusty conditions on these mines.

## 1. OBJECTS OF DUST SAMPLING

These can best be stated in the words used by Beadle<sup>1</sup> during the 1959 conference:

'The particular object in any given case may be one or more of the following:

- i. To detect working places with unsatisfactory dust conditions.
- ii. To determine the causes of such conditions.
- iii. To indicate the necessary control measures.
- iv. To determine the effectiveness of dust suppression methods or equipment.
- v. To confirm that satisfactory conditions have been obtained after remedial action, and that they remain satisfactory.
- vi. To provide records of dust conditions so that trends can be assessed.
- vii. To correlate dust exposures with incidence of disease.
- viii. To comply with Regulations.'

## 2. DUST SAMPLING INSTRUMENTS

The earliest dust measurements were made by means of the sugar tube. Initially no attempt was made to eliminate large particles, but as from 1912 large particles (above about 75 microns) were eliminated by rinsing the dust through a 200 mesh gauge. Later a still finer mesh gauge was used.

The number of samples taken by means of the sugar tube increased to about 35,000 during 1919 and then gradually diminished to 17,000 during 1936. It was then abandoned because, apart from the cumbersomeness of the equipment and the laboriousness of the method, the improved dust conditions made the method even less accurate than before.

The Kotzé konimeter came into use in 1916 and was later followed by the circular konimeter and in 1948 by the Witwatersrand konimeter. All the konimeter results refer to number counts after ignition to burn off carbon particles and treatment with hydro-

chloric acid to dissolve soluble salts.

The konimeter is still being used for all routine work, except in a few mines which have recently started using a modified thermal precipitator on an experimental basis. Various types of thermal precipitator are being used for research work.

## 3. RECORDED DUST CONDITIONS

At present mine officials take about half a million konimeter samples per annum, mainly to comply with Regulations and to detect working places with unsatisfactory conditions.

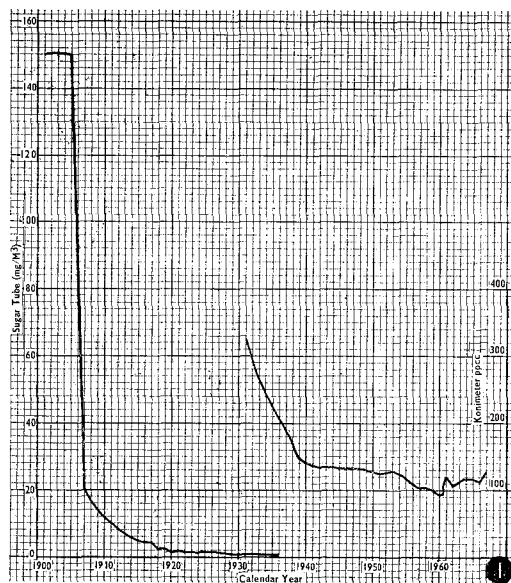


Fig. 1. The change in the annual dust index for mines of Group A.

In addition, Government Inspectors of Mines take about 30,000 samples per annum during routine inspections. These results are classified into 36 different classes of place and they are published annually. Of these, Du Toit<sup>2</sup> used 6 strategic classes of place in his doctoral thesis to determine a 'dust index' for each year. The results are given in Table 1 and Fig. 1. The 6 classes of place

selected are the tops of downcast shafts, the bottoms of downcast shafts, main intake airways away from downcast shafts, stopes, development ends and sinking shafts.

TABLE I: ANNUAL DUST INDICES

| Year | Sugar Tube<br>Milligrams per<br>Cubic Metre | Konimeter ppcc<br>(corrected for<br>Old Microscopes) |
|------|---------------------------------------------|------------------------------------------------------|
| 1901 | 150                                         |                                                      |
| 1905 | 150                                         |                                                      |
| 1907 | 20                                          |                                                      |
| 1915 | 4.9                                         |                                                      |
| 1916 | 4.6                                         |                                                      |
| 1917 | 4.6                                         |                                                      |
| 1918 | 2.8                                         |                                                      |
| 1919 | 2.2                                         |                                                      |
| 1920 | 1.7                                         |                                                      |
| 1921 | 1.6                                         |                                                      |
| 1922 | 1.4                                         |                                                      |
| 1923 | 1.2                                         |                                                      |
| 1924 | 1.0                                         |                                                      |
| 1925 | 1.0                                         |                                                      |
| 1926 | 1.1                                         |                                                      |
| 1927 | 1.1                                         |                                                      |
| 1928 | 0.8                                         |                                                      |
| 1929 | 0.9                                         |                                                      |
| 1930 | 0.7                                         |                                                      |
| 1931 | 0.8                                         | 323                                                  |
| 1932 | 0.8                                         |                                                      |
| 1933 | 0.8                                         | 269                                                  |
| 1934 | 0.8                                         |                                                      |
| 1935 | 0.8                                         | 224                                                  |
| 1936 | 0.6                                         |                                                      |
| 1937 |                                             | 190                                                  |
| 1939 |                                             | 146                                                  |
| 1941 |                                             | 139                                                  |
| 1943 |                                             | 135                                                  |
| 1945 |                                             | 133                                                  |
| 1947 |                                             | 131                                                  |
| 1949 |                                             | 130                                                  |
| 1951 |                                             | 125                                                  |
| 1953 |                                             | 129                                                  |
| 1955 |                                             | 117                                                  |
| 1956 |                                             | 108                                                  |
| 1957 |                                             | 102                                                  |
| 1958 |                                             | 102                                                  |
| 1959 |                                             | 100                                                  |
| 1960 |                                             | 93                                                   |
| 1961 |                                             | 120                                                  |
| 1962 |                                             | 107                                                  |
| 1963 |                                             | 113                                                  |
| 1964 |                                             | 119                                                  |
| 1965 |                                             | 119                                                  |
| 1966 |                                             | 111                                                  |
| 1967 |                                             | 128                                                  |

The konimeter results for the period 1931 to 1956 were corrected for differences due to gradual replacement of old methods and microscopes by more refined methods and microscopes.

These results demonstrate the spectacular improvements which were achieved between

1901 and 1924 and the very marked improvement from then till 1960. Since 1960 conditions have certainly not improved and there are even indications of a slight deterioration.

#### 4. POSSIBLE NEW DUST SAMPLING STRATEGIES

The following statement made by Kitto<sup>3</sup> at the 1959 conference is, in most respects, still valid today:

'In the gold mines, where routine dust sampling is carried out by the mines themselves, the konimeter is still the routine instrument used, in spite of its limitations. It is a more robust, compact, and reliable instrument than the thermal precipitator, and these advantages, together with the short period required for sampling, have been sufficient in the past to outweigh any considerations about the greater accuracy of the thermal precipitator. The complete lack of proof, so far, that the thermal precipitator gives a closer correlation with the incidence of silicosis does not help to persuade the mining personnel that its adoption is desirable.

Various other instruments for determining number concentration have been tried from time to time, but they have all proved unsatisfactory in some way or other.'

However, there have been some developments during the past 10 years which tend to alter the situation.

i. The new modified thermal precipitator which is at present being tested as a routine instrument on four mines for a period of six months, is comparatively robust and compact and requires only five minutes for the taking of a sample.

ii. The samples from this instrument can be quickly and reliably evaluated by means of the diffraction size frequency analyser (Disa).

iii. The samples are amenable to celloidin-acid treatment which improves the reliability of the results when surface area is measured instead of number concentration.

These developments may result in the konimeter being replaced as the basic sampling instrument by the new modified thermal precipitator. However, the author, as a practical mining man, will be very sorry to see the konimeter deposed. Notwithstanding its known shortcomings, it has given sterling service in the past and any new instrument will have its own quota of shortcomings.

The fact is that the risk of pneumoconiosis cannot be reduced by more or better sampling, but only by overcoming the human element which is for various reasons unwilling to apply known methods of dust suppression.

In terms of paragraph 64 (2) (a) of the Pneumoconiosis Compensation Act No. 64 of

1962, the government has established a Pneumoconiosis Risk Committee whose function it is to estimate the pneumoconiosis risk to which persons employed in a dusty atmosphere in each mine are exposed.

Differential levy rates are to be applied to mines based on their individual risk indices, one of the objects being to provide an incentive for the taking of measures to prevent the release of dust. The author doubts whether a reliable risk index can ever be determined by means of dust sampling and also whether the object will be achieved by means of differential levies, because dust levels are affected more by the attitude of the miners than of management. However, if the Com-

mittee does decide to base its risk index on a dust index, it is very likely that the modified thermal precipitator with assessment by means of DISA will prove the most suitable method. Sampling would naturally have to be carried out by a team independent of the individual mines.

#### REFERENCES

1. Beadle, D. G. (1959): *In Proceedings of the Pneumoconiosis conference, Johannesburg, p. 4.*
2. Du Toit, R. S. J. (June 1968): *The functional relationship between dust hazard and the rate of collecting funds to pay compensation for pneumoconiosis*, Ph.D. Thesis.
3. Kitto, P. H. (1959): *In Proceedings of the Pneumoconiosis Conference, Johannesburg, p. 14.*