Acclimatizing Men to Heat in Climatic Rooms on Mines

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Discussion

C. G. Hinds (Member): The climatic chamber at Kloof Gold Mine was built to the design referred to in the paper presented by Professor Wyndham and Dr Strydom. As no suitable underground facilities existed for the acclimatization of labourers at the rate required, mining operations would have been severely restricted had there not been a climatic room timeously built on surface.

The climatic room can accommodate 120 labourers per 4½ hour shift. The standards laid down by the Human Sciences Laboratory were and still are being adhered to as strictly as possible. Through a shortage of European personnel the recommended degree of white supervision could not be adhered to and the use of Bantu assistants with a minimum education of Standard 8 was introduced. This is considered to have met with sufficient success to warrant acceptance as policy.

The climatic room was brought into operation on the 1st September, 1967, i.e. two months after stoping at Kloof was commenced. The figures quoted herein therefore pertain to the period between that date and the 31st March, 1969, when the main shaft and the main surface fans were commissioned.

During the 20 months of stoping prior to the commissioning of the main shaft, mining operations at Kloof were effected through the Harvie Watt shaft of the Libanon Gold Mining Company Limited. In this period 10 452 Bantu labourers were acclimatized in the following categories:

Experienced workers	7 326
New to the industry	2 086
Re-acclimatized	1 040

It will be noted that during the period, labourers 'new to the industry' averaged 22 per cent of the intake. This percentage fluctuated from time to time and reached 42 per cent. (The present percentage is 60.)

The greatest number acclimatized during any one month occurred in February, 1969 when 1 234 Bantu were treated. The greatest number of Bantu acclimatized during any 8-day period was 411. As many as four × 4½ hour shifts were run in 24 hours.

The number of men found to be heat intolerant over the period of 20 months was 33 out of a total 9 412 Bantu.

The following tabulation illustrates the history of the build-up of manpower and the climatic conditions under which they worked:

Date	Max. No. Bantu U/G	Monthly tonnage handled (all sources)	Volume of air circulated at U/G density in cfm.	Volume of air per person in cfm.	U/G Temps. in working places Development and stoping			Remarks
					Lowest °F	Highest °F	Average °F	
Sept. 67	On 26/9/67 2346	71 612	112 000	43·9	76·5 / 82·3	86·1 / 86·8	83·9 / 85·7	Surface Acclimatization
May, 68	On 25/5/68 3677	109 761	246 000	62·7	75·6 / 82·0	90·0 / 91·2	83·6 / 86·1	
Mar. 69	On 22/3/69 6382	101 770	349 000	49·4	82·0 / 86·0	91·2 / 95·4	88·8 / 89·8	
Apr. 69	On 26/4/69 7073	101 949	593 000	76·9	75·5 / 81·0	90·0 / 90·5	84·3 / 85·4	Surface fan running

The areas worked were sited between 5 016 ft and 6 365 ft below surface.

Virgin rock temperatures ranged between 92°F and 99°F.

Stopes are cleaned by hand lashing.

The average dip of the reef is 35°.

The number of heat stroke and heat exhaustion cases during the period of 20 months under most difficult ventilation conditions was Nil.

P. G. D. Pretorius (Member): I would like to congratulate the authors on the interesting and lucid and, may I add, modest way in which they have presented a description of a most important advance in the acclimatization of our Bantu mineworkers.

On City Deep Limited we originally established a climatic chamber in 1966 for the following main reasons:

(1) Suitability of this method of acclimatization to our conditions

The original two-stage method of acclimatization had served well but suffered from some major disadvantages:

In a deep, low dip mine face cleaning is generally by scraper. To provide rock for lashing it was necessary to make the cleaning less efficient by moving the scraper to behind the first row of supports. The workers being acclimatized had to shovel the rock on the face and throw it back to the scraper path. This was an unsatisfactory procedure as the amount of broken rock available on the face, its degree of comminution and the distance of throw could vary daily. This in turn led to a varied work rate and total work output.

Due to shortage of available face and the undoubted benefits of maximum face advance, face cleaning is generally done on night shift. For various reasons it was not possible to do acclimatization on night shift and thus maximum face advance was interfered with. The faces on which acclimatization was done often showed a lesser rate of face advance compared with stopes cleaned on night shift.

It often proved difficult to achieve the required temperature in the two classes of working places. The 'cool' stopes always tended to become too hot and, worse still, the 'hot' stopes become too cool. We thus had to step in and deliberately worsen conditions in the latter case. This not only affected all the other workers in the acclimatization stopes but often also in adjacent stopes in the longwall.

As each face could only accommodate a limited number of workers being acclimatized a large number of faces and, consequently, a large staff had to be applied to this task.

The climatic chamber method of acclimatization offered none of the above disadvantages.

(2) Improved standard of acclimaziation

The two-stage method of acclimatization could not be guaranteed to give optimum acclimatization as the work rate and total output perforce depended on the amount and type of rock to be shovelled and the distance it had to be thrown. Furthermore it involved spreading the workers along a fair length of face, making close supervision of each individual difficult. It was possible for workers to slacken off while the supervisors were busy elsewhere.

The stepping method offers a far more readily controlled work rate, work output and environmental temperature. Close supervision of a larger number of workers by each supervisor is possible, thus greatly diminishing the chances of anybody slackening off. Body temperature checking is much easier to do and the physical signs of heat distress more readily observed.

(3) Increased productivity of the method

This stems from two main factors, viz.:

The reduction in the acclimatization period from 12 to 8 shifts increased the useful work that could be performed. As the output of the stopes did not drop when the acclimatization gangs were removed, this is a very real improvement of four useful working days per worker for every contract. It was not possible to train men in anything but lashing under the old scheme—now they are available to be taught for almost half the shift, contemperaneously with acclimatization. Thus a further saving of six shifts is achieved.

The workers are more fit after eight days of stepping than after twelve days of lashing under the old scheme, and thus able to reach full productivity sooner in their jobs.

(4) Actual savings in personnel

In these days of shortage of skilled personnel, especially European, the release of men from acclimatization supervision to production is a valuable factor.

(5) Elimination of heat intolerant men

There was always a doubt as to whether a sufficient state of heat stress was being generated in all subjects by the old method, so as to select all heat intolerant men. This doubt does not exist with the new method.

Once having decided on climatic room acclimatization the merits of surface and underground chambers were considered. Although a surface chamber looked attractive by reason of its siting near compound and hospital, convenience of supervision by persons no longer fit for underground work and close control of environment, the advantages of an underground chamber proved far greater. The chief of these merits are:

(*a*) *Conditioning of the trainee*

While the stepping method adequately achieves physiological conditioning to heat and work, psychological conditioning to underground conditions can only be achieved by sending the raw recruit underground. He usually comes from a primitive, rural environment to the bustling life in the compound. Added to the strangeness of his new environment are the hair-raising tales of the work and dangers underground, well-embroidered for his benefit. This sense of apprehension is only lost after a few days experience and familiarization with the conditions of darkness, heat, enveloping rock walls and crampled working space. It is far better that this familiarization should take place in the sympathetic atmosphere of the underground training and acclimatization centres than in the rough and ready atmosphere of the working stope.

(*b*) *Actuality of the training environment*

We believe that training should be done in underground stopes where the work done is actual mining operations, not artificially contrived. To co-ordinate training and acclimatization it is therefore necessary that the latter should be done in an underground chamber in close proximity to the training centre.

(*e*) *Cost of establishing an acclimatization centre*

As disused haulages in good condition were available the cost of establishing an underground centre were considerably cheaper than would have been the case with a surface chamber.

(*c*) *Operating cost of acclimatization centre*

As upcast air of an even temperature and humidity was available in large quantities a considerable saving in operating costs was possible. Maintenance costs are negligible.

As a bonus we found that the air temperature was raised from an intake level of 86°F W.B. to 92°F W.B. at the end of the tunnel by the heat input from the workers stepping. Thus, on successive days, the rate of work and the temperature increases in the centre.

FUTURE PLANNING

After serving the mine well for more than three years it was decided to withdraw from the established acclimatization area. The question of surface compared to underground climatic chamber acclimatisation was again examined and it was again decided to establish an underground acclimatization centre, identical in design to the first one. When the question of an acclimatization centre for Crown Mines was raised, it was decided without hesitation to instal an underground centre, although facilities were not nearly so readily available as in the case of City Deep.

The results obtained in the case of City Deep amply justified our reasoning. The only trouble experienced to date was due to lowering of the upcast air temperature in winter. This was ultimately balanced by decreasing the intake quantity and injecting some air halfway along the tunnel to adjust the resulting final temperature to 92°F W.B.

D. F. H. Grave* (Member): First I would like to congratulate the authors on their paper which very ably lists the advantages resulting from climatic room acclimatization. The paper covers the ground very fully and there is little left for a contributor to add.

The climatic room system has been in use in this Group for over three years and, with one exception, all our gold mines are now using climatic rooms, eight on surface and two underground. One mine makes use of the facilities of a neighbouring mine, and one still uses underground stope acclimatization.

Managers and officials concerned with acclimatization are generally enthusiastic about the improvements brought about by this system, although there are some differences of opinion as to the magnitude of the benefits gained.

In general, the greatest practical benefits result from:

1. Combining a period of training and induction with the acclimatization period. Typically, the trainee does a 4-hour acclimatization shift each day, together with a 2-3 hour induction and training period. Previously the induction and training period was separate and involved 4-5 days. In addition, with surface climatic rooms all unproductive shaft and underground travelling time, waiting, etc., is eliminated.
2. No time is lost in getting a new labourer 'onto the job'. Recruits can start their acclimatization, plus induction, etc., the day after arrival. Abnormal influx of labour can be accommodated by working extra shifts in the acclimatization centre.

   All this results in the labourer becoming productive much earlier than under the old system.
3. Control of environmental conditions and supervision of the work rate of each individual are very much better with the new system. Underground acclimatization stopes always involved the men being scattered over a wide area which led to non-uniform temperature conditions as well as to lack of effective supervision and difficulty in maintaining a satisfactory work rate.
4. Detection of, and attention to, cases of high body temperatures are infinitely better with the new system.

Discussion with acclimatization personnel, including Bantu supervisors, shows that the system is popular with the trainees. They have the feeling of being 'prepared for the job'; this feeling was often absent under the old system, where the acclimatization labourers felt that they were being sent straight into productive work. Interference with acclimatization gangs by miners seeking extra labour for lashing, etc., is of course eliminated under the new scheme.

The cost of acclimatizing labourers varies considerably from mine to mine, but the cost of surface acclimatization has generally been found to be very much less than underground. Typical figures are 22½ cents per shift per labourer under surface acclimatization as against 48 cents under the old system.

The staff required also varies appreciably, but is again much less on surface than underground. Some mines make more use of African acclimatization supervisors than others.

Typical findings as to staff required are:

To acclimatize 240 labourers in a surface climatic chamber requires 1 European supervisor, 4 Bantu clerks and 12 boss boys.

To acclimatize 100 labourers underground requires 1 shift boss and 10 boss boys.

The capital cost of the surface climatic chamber on one mine, which handles some 8 000 men per year, was R68 000. Annual running and maintenance costs are estimated at R7 200. However, the benefits of the system have quickly overtaken this outlay.

AUTHOR'S REPLY

Dr C. H. Wyndham (Member): The complimentary remarks on the climatic room acclimatization procedure made by Mr Pretorius are appreciated. The fact that City Deep, where the two-stage procedure was developed, was among the first to adopt the climatic room method indicates the progressive attitude of its management. We are more than grateful for the co-operation the Laboratory has received in the past from this mine.

The practical information provided by Messrs Hinds and Graves on certain issues of the acclimatization procedure is not only interesting but also adds to the value of the paper. It certainly is heart-warming to note that no heat stroke case has been reported from Kloof mine during the rather hectic initial years of starting up operations. The fact that underground environmental temperatures during these years were rather on the high side lends proof to the effectiveness of climatic room acclimatization. It is doubtful whether two-stage acclimatization under identical conditions would have been as successful.

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