# 18 ACOUSTIC ENVIRONMENTAL HAZARDS OF WORK ON MAIN ROAD HAULAGE LEVELS IN THE COAL MINE

## 18.1 Introduction

The main task of the horizontal transport in underground coal mines is to move the masses mined from winning machines or loading the output expansion tanks moving vertical transportation equipment. Most coal mines in this process are used in conveyor belts [1, 2, 3, 4].

Belt conveyors, continuous motion, are mechanical, pneumatic or hydraulic means of transport, in which material is transported in a precise way is moved continuously at a fixed or variable speed. The conveyor belt consists of many assemblies and components (fig. 18.1).

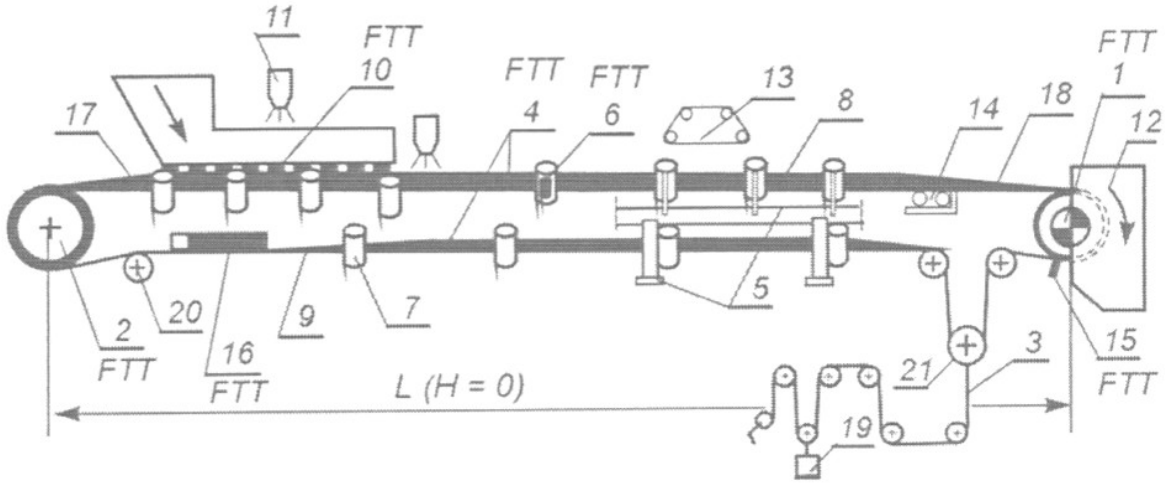


***Fig. 18.1 Schematic of a conveyor belt [3]***

The teams are the main belt (fig. 18.1): 1 - Drive headend equipped with a drum dump and boom, 2 - To return equipped with the components forming the final part of the conveyor. 3 - belt tensioning station, 4 - tape, 5 - the route which provides a supporting structure for sets krążnikowych, 6, 7, 8, 9 - a set of rollers and idlers, used for supporting and guiding the tape, 10 - the loading station, 12 - station unloading.

Teams are additional conveyor (see fig. 18.1): 11 - Water sprinkler output, 13 - nadtaśmowy magnetic separator, 14 - the weight of power, 15 - scraper, 16 - scraper, 17, 18 - a device to facilitate changing the shape of a flat strip of nieckowaty and vice versa, 19 - gravity belt tensioning device, 20 - drum deflection, 21 - drum tension.

The advantage of the transport belt is easy to adjust the route to the area with variable slope (permissible slope ranges from $15^0$ to $17^0$), lightweight design supporting achieved due to uniform distribution load, the use of the workings of small cross sections, very high performance, continuous nature of work, little effort service. A disadvantage of the transport belt is a little flexibility in operating the serial string of conveyors and sensitivity to the presence

of lumps of large size and sharp edges, and the relatively low durability of the tape which is the most expensive element of the conveyor and which makes a noise.

Working with the manufacturing process emits excessive noise makes it difficult to communicate with employees, reduces productivity, increases such irritability, causing a feeling of dementia and often leads to severe hearing disorders. Given the above, take the work because of the need to change this state consisting of the first stage of identifying the risks acoustics. This will allow the identification of hazards, in a further step to examine the possibilities to minimize noise such as a specific technology node or element.

## 18.2 Characteristics of the main haulage level in the analyzed coal mine [5]

Below are presented the characteristics of conveyor transport system used in the main haulage levels in the dig and excavation at the level of 850 [m] under the ground to the glass tank.

Excavations, which are mounted spoil conveyors transport system are also a way of passage for men. The transition is located along the conveyor. The main haulage leveled of five conveyor belts:

- Gwarek 1 -1 400 670m in length (referred to in documents as a technical manual Pioma I)
- Gwarek 2 - 1400 with a length of 1650m
  (referred to in documents as a technical manual Pioma II),
- Gwarek 3 -1 200 300 m in length, Mifama 4 - 1200, length 360m, Nowomag -1200.

Tab. 18.1 summarizes the most important parameters of the main conveyor haulage.

***Tab. 18.1 Summary of main parameters of conveyor haulage main-leveled***

| **Nr of Conveyor** | | **Nowomag** | **Gwarek I** | **Gwarek II** | **Gwarek III** | **Mifama IV** |
|---|---|---|---|---|---|---|
| **Band width** | [mm] | 1200 | 1400 | 1400 | 1200 | 1200 |
| **Belt speed** | [m/s] | 3,22 | 3,15 | 3,15 | 2,97 | 2,9 |
| **Total power units** | [kW] | 2x 250 | 2x250 | 3x250 | 2x132 | 4x75 |
| **Perm. max. inclination - for chloroprene rubber band and,-for PVC tapes.** | [º] | +16/-14<br>+14/-12 | +16/-14<br>+14/-12 | +16/-14<br>+14/-12 | +16/-14<br>+14/-12 | +16/-14<br>+14/-12 |
| **Slope of the conveyor** | [º] | 0 | 0 | 0 | 0 | 0 |
| **Performance** | [t/h] | 1200 | 2600 | 2600 | 1340 | 1200 |
| **Voltage** | [V] | 1000 | 1000 | 1000 | 1000 | 1000 |
| **Length of the conveyor** | [m] | 1000 | 670 | 1650 | 300 | 360 |

## 18.3 Noise emission tests on the main haulage road

The study was conducted on the entire main road haulage selected level (850 [m] underground) coal mine in April 2011. Particular attention has been selected subject areas in an interview after the analysis of environmental and noise wstępnej.Poziom was measured by the correction curve A and C sonometers Brüel & Kjaer type 2260, and verified device 948th SVAN The measurement was performed using the indirect method. Selected areas:

- Area of operation and control of the conveyor drive units Gwarek I (named in the documentation of mine Pioma I),
- Area of operation and control of the conveyor drive units Gwarek II (named in the documentation of mine Pioma II),
- Area of operation and control of the conveyor drive units NPD 3,
- Area of operation and control of the conveyor drive units Mifama IV,
- Operation and monitoring of devices Nowomag conveyor.

Preliminary studies tab. 18.2 presents the results of studies conducted in selected areas.

Data analysis identified initial areas of increased emission of sound in the work environment. For the remainder of the study were classified areas: control of devices and power conveyor Gwarek, Gwarek II.

***Tab. 18.2 Results of preliminary measurements of the initial***

| Aeras of measurement | Time | Equivalent sound pressure level A | Maxium sound level A | | | Top sound level C | | | Exposure level for 8 h calculation | | | Evaluation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Intentional | Standard | Exceeding | Measured | Standard | Exceeding | Calculated | Standard | Exceeding | |
| | [min] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | |
| **Operation and control of devices conveyor Pioma I** | 350 | 91,9 ±1,1 | 103 | 115 | - | 106,6 | 135 | - | 91,8 | 85 | 6,8 | NStd |
| **Operation and control of devices conveyor NPD 3** | 330 | 82,3 ±1,1 | 89 | 115 | - | 104 | 135 | - | 84,1 | 85 | - | Std |
| **Operation and control of devices conveyor Pioma II** | 340 | 96,4 ±1,1 | 98,2 | 115 | - | 104,9 | 135 | - | 96,3 | 85 | 11,3 | NStd |
| **Operation and control of devices conveyor Mifama IV** | 320 | 86,1 ±1,1 | 90,3 | 115 | - | 111,2 | 135 | - | 85,9 | 85 | 0,9 | NStd |
| **Operation and control of devices conveyor Nowomag** | 330 | 86,3 ±1,1 | 106, 6 | 115 | - | 108,5 | 135 | - | 84 | 85 | - | Std |

***NStd – No standard, Std – Standard***

## 18.4 Measurement of specific

***Drive and around the conveyor Gwarek I - 1400 - L = 670m, (Pioma I)***

Powertrain Pioma IL = 670m conveyor Gwarek I -1400 [mm] is built on the main haulage transport system at a level 850 [m]. The conveyor tunnel runs to a storage reservoir. The area studied is a belt drive power 2x250 [kW], the supply voltage 1000 [V] and 1036 [mm], arm length 9130 [mm] along with the head chute to a storage reservoir and a loop length of 2100 [mm].

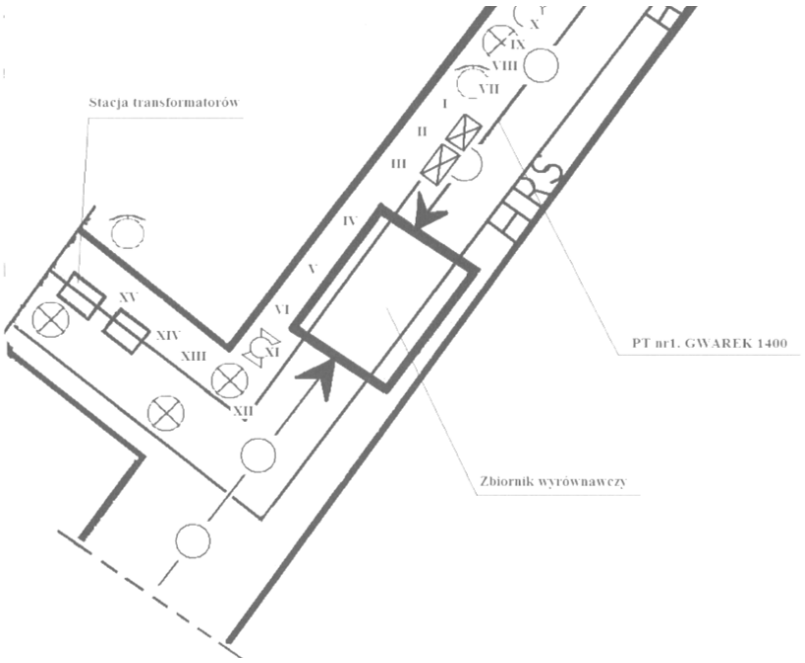


***Fig. 18.2 Distribution points Pioma I***

In the area of handling and control of conveyor Gwarek I always worked at least two employees, whose job is to control the correct operation of the conveyor belt control connection state, state rolkotrzymaczy, rollers, chains, supporting the construction of the conveyor, the control mesh trays pętlicowych shields, its operation and care of cleanliness and maintenance of both the conveyor and place of work. The average working time of workers in the area of exposure is 350 [min]. Employees who reside within the belt in other than the above. changes are exposed to noise throughout his shift.

Detailed measurements were performed using the indirect method. It consists in measuring the same parameters as in the direct method, but in less time than worker exposure to noise. The measurement was performed during the first shift, at around 11.00. The noise measurement took 3 points around the drive, 3 points in the area of repose to a storage reservoir, and after a few points every 2 feet on either side of the drive until it reaches a level below the limit value.

The individual measurement points are presented in fig. 18.2, while the results are presented in tab. 18.3.

*Tab. 18.3 The results of research in the area of operation and control of conveyor equipment Pioma I*

| Measure point | Exposure time | Equivalent sound level A | Average equivalent of sound pressure level | Maximum sound level A | | | Top sound level C | | | | Exposure level for 8 h calculation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Measured | Norm | Exceeding | Measured | Average | Norm | Exceeding | Measured | Norm | Exceeding |
| | [min.] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| I | 350 | 95,3<br>94,1<br>94,6 | 94,7 | 95,3 | 115 | - | 106,6<br>103,2<br>102,6 | 104,1 | 135 | - | 93,3 | 85 | **8,3** |
| II | 350 | 94,1<br>95,5<br>93,6 | 94,1 | 95,5 | 115 | - | 102,6<br>104,1<br>99,3 | 102 | 135 | - | 92,7 | 85 | **7,7** |
| III | 350 | 87,9<br>91,2<br>90,3 | 89,8 | 91,2 | 115 | - | 100,3<br>100,6<br>102,3 | 101,1 | 135 | - | 88,4 | 85 | **3,4** |
| IV | 350 | 88,8<br>83,7<br>86,2 | 86,2 | 88,8 | 115 | - | 103,9<br>109,2<br>106,3 | 107 | 135 | - | 84,8 | 85 | - |
| V | 350 | 103,2<br>93,1<br>89,1 | 95,1 | 103,2 | 115 | - | 112,6<br>111,7<br>109,5 | 111,3 | 135 | - | 93,7 | 85 | **8,7** |
| VI | 350 | 84,1<br>90,5<br>87,4 | 87,3 | 90,5 | 115 | - | 106,2<br>102,3<br>100,1 | 102,9 | 135 | - | 85,9 | 85 | **0,9** |
| VII | 350 | 87,5<br>90,1 | 88,8 | 90,1 | 115 | - | 99,3<br>99,6 | 99,5 | 135 | - | 87,5 | 85 | **2,5** |
| VIII | 350 | 89,2<br>84,9 | 87,5 | 89,2 | 115 | - | 98,2<br>100,1 | 99,2 | 135 | - | 86,1 | 85 | **1,2** |
| IX | 350 | 85,0<br>82,9 | 83,9 | 85 | 115 | - | 97,9<br>99,1 | 98,5 | 135 | - | 82,5 | 85 | - |
| X | 350 | 83,4<br>81,2 | 82,3 | 83,4 | 115 | - | 98,2<br>97,9 | 98,5 | 135 | - | 80,9 | 85 | - |
| XI | 350 | 89,1<br>87,3 | 88,2 | 89,1 | 115 | - | 106,1<br>96,4 | 101,2 | 135 | - | 86,8 | 85 | **1,8** |
| XII | 350 | 86,6<br>85,5 | 86,1 | 86,6 | 115 | - | 98,7<br>99,1 | 98,9 | 135 | - | 84,1 | 85 | - |
| XIII | 350 | 80,5<br>79,6 | 80,5 | 80,5 | 115 | - | 90,3<br>89,9 | 90,1 | 135 | - | 79,1 | 85 | - |
| XIV | 350 | 75,3<br>76,6 | 75,9 | 76,6 | 115 | - | 83,1<br>86,6 | 84,8 | 135 | - | 74,5 | 85 | - |
| XV | 350 | 59,1 | 58,6 | 59,1 | 115 | - | 64,4 | 63,8 | 135 | - | 57,2 | 85 | - |

***Drive and around the conveyor Gwarek II - 1400 - L = 1650m (Pioma II)***

The drive unit of the conveyor Gwarek Pioma II II - 1400 L = 1650 [m] an installed capacity of 3x250 [kW] and a supply voltage 1000 [V] consists of a shell of the drive components which are disjoint. The walls of the drive drum bearings 1036 [mm] and 1042 [mm].

The conveyor is located in the dig, and an indirect fire between the main haulage conveyor Gwarek Gwarek I and III. In the area of handling and control of the conveyor drive Gwarek II work always at least one employee, whose duties and responsibilities are the same as in the case of manual conveyor Gwarek I. An additional responsibility is the control node przesypowego. Working time and rest is the same as in case of the main haulage. The time of exposure to noise in the area is 340 [min].

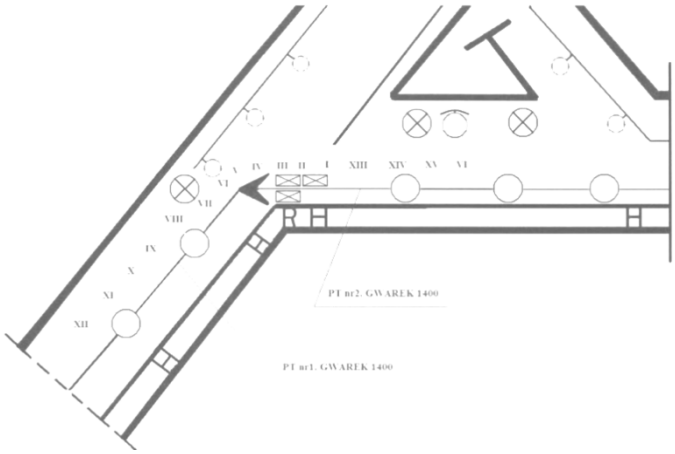


***Fig. 18.3 Distribution of measurement points in the area of handling and control of conveyor Pioma II***

Detailed measurements were performed using the indirect method. The noise measurement took 3 points around the drive, 3 points in the area Flow Rate, and after a few points every 2 feet on either side of the drive until it reaches a level below the limit value. The individual measuring points are shown in Figure 3 Table 4 presents the results of detailed measurements of local services such as conveyor drive Gwarek II Pioma II and the local node przesypowego, noose and a few meters in both directions, from the Flow Rate (item VII-XII) and in the opposite direction starting from the extreme point of the drive (section XIII-XVI).

***Tab. 18.4 The results of research in the area of operation and control of conveyor equipment Pioma II***

| Measure point | Exposure time | Equivalent sound level A | Average equivalent of sound pressure level | Maximum sound level A | | | Top sound level C | | | | Exposure level for 8 h calculation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Measured | Norm | Exceeding | Measured | Average | Norm | Exceeding | Measured | Norm | Exceeding |
| | [min.] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| I | 340 | 87,2<br>87,0<br>90,3 | 88,2 | 90,3 | 115 | - | 103,5<br>103,8<br>107,2 | 104,8 | 135 | - | 86,7 | 85 | **1,7** |
| II | 340 | 95,6<br>87,4<br>87,2 | 90,0 | 95,6 | 115 | - | 109,1<br>102,6<br>103,5 | 105,1 | 135 | - | 88,5 | 85 | **3,5** |

| Measure point | Exposure time | Equivalent sound level A | Average equivalent of sound pressure level | Maximum sound level A | | | Top sound level C | | | | Exposure level for 8 h calculation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Measured | Norm | Exceeding | Measured | Average | Norm | Exceeding | Measured | Norm | Exceeding |
| | [min.] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] | [dB] |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| III | 340 | 86,9<br>89,3<br>87,4 | 87,9 | 89,3 | 115 | - | 100,7<br>104,6<br>103,9 | 103,1 | 135 | - | 86,4 | 85 | **1,4** |
| IV | 340 | 95,2<br>98,6<br>100,4 | 98,1 | 100,4 | 115 | - | 104,1<br>105,3<br>112,7 | 107,4 | 135 | - | 96,6 | 85 | **11,6** |
| V | 340 | 98,2<br>101,3<br>99,6 | 99,7 | 101,3 | 115 | - | 107,7<br>113,2<br>109 | 110 | 135 | - | 98,2 | 85 | **13,2** |
| VI | 340 | 98,9<br>100,1<br>102,5 | 100,8 | 102,5 | 115 | - | 108,3<br>110,9<br>113,7 | 111 | 135 | - | 99,3 | 85 | **14,3** |
| VII | 340 | 97,6<br>97,9 | 97,8 | 97,9 | 115 | - | 108,3<br>102,3 | 105,3 | 135 | - | 96,3 | 85 | **11,3** |
| VIII | 340 | 95,2<br>93,7 | 94,5 | 95,2 | 115 | - | 100,3<br>98,9 | 99,6 | 135 | - | 93 | 85 | **8** |
| IX | 340 | 94,5<br>92,4 | 93,5 | 94,5 | 115 | - | 102,1<br>97,6 | 99,9 | 135 | - | 92 | 85 | 7 |
| X | 340 | 90,1<br>90,6 | 90,4 | 90,6 | 115 | - | 98,5<br>102,2 | 100,4 | 135 | - | 88,9 | 85 | **3,9** |
| XI | 340 | 87,3<br>84 | 85,7 | 87,3 | 115 | - | 98,3<br>96,7 | 98 | 135 | - | 84,2 | 85 | - |
| XII | 340 | 82,1<br>83,4 | 82,8 | 83,4 | 115 | - | 97,4<br>99,8 | 102,2 | 135 | - | 81,3 | 85 | - |
| XIII | 340 | 90,2<br>87,4 | 89,8 | 90,2 | 115 | - | 103,5<br>99,4 | 101,5 | 135 | - | 88,3 | 85 | **3,3** |
| XIV | 340 | 89,2<br>85,5 | 87,4 | 89,2 | 115 | - | 100,6<br>98,2 | 99,4 | 135 | - | 85,9 | 85 | **0,9** |
| XV | 340 | 83,4<br>83,6 | 83,5 | 83,6 | 115 | - | 95,3<br>97,4 | 96,4 | 135 | - | 82 | 85 | - |
| XVI | 340 | 82,7<br>83,8 | 83,3 | 83,8 | 115 | - | 97,9<br>97,1 | 97,5 | 135 | - | 81,8 | 85 | - |

## 18.5 Analysis of detailed measurements

***Drive and around the conveyor Gwarek I - 1400 - L = 670m (Pioma I)***

Execution of detailed measurements allowed to determine the noise level they need to stay the personnel operating the conveyor drive Gwarek I (the results are shown in Table 3). Exposure time used for the calculations at each point was the same because of the continued movement of people into the area. However, due to increased residence time in the area around the conveyor, the control device and installed telephone density of measurement points were around the same drive and the chute into the tank. In these places the greatest excess emissions recorded sound in a row to 8.7 [dB]. Studies have shown that the noise levels tested by a curve correction of A and C is not exceeded in either a single point. The local

drive, ie a distance of about 7.5 [m] (measuring point I-III), the distance created by the extreme points of transmission, the equivalent sound level varied between 94,7-89,8 [dB]. This led to excess exposure to noise in a single shift in the range of 8,3-3,4 [dB]. Two extreme excess were measured at study successively the first and second gears. The difference with a value of 5 [dB] indicates the source of noise. Particularly noteworthy is the large difference in sections IV, V, VI. During the observation and measurement of output conveyor, which has traveled a different granularity. Initially, the conveyor transported small, free-flowing materials and mud and had to be applied to the conveyor at a standstill. This resulted in a lack of exceedances in the studied area. Then when you start delivery of supplies and fronts spoil haulage on the main sequence, granulation radically changed. Were transported assortments of coal and stone blocks of varying volume and overall dimensions. This output boom pouring takes a different kinetic energy. During the study area boundaries were defined exposure to noise exceeded during a single shift. The measurement was made at one meter from the extreme point of the drive towards noose, and at 2 meters in the opposite direction, from the point IV. The results clearly show that noise exposure zone occurs at a distance of six meters from the extreme point of the drive. A similar situation can be seen going in the opposite direction. Here, the exposure level is normal now in the fourth subway. In the second case, when the test is a safety zone from the tank a huge impact on reducing the sound level adjacent to the excavation location, because behind the dam reservoir is endless tunnel, then enter the block, where the transformer station. There is a zone located at a reduced sound pressure level, available to employees working in the handling conveyor Gwarek I. The zone has been tested and marked the point of XV. The sound pressure level is there a value of 57 [dB], which is almost half that in the workplace. It is comparable with the level of sound that accompanies the work of such office.

***Drive and around the conveyor Gwarek II - 1400 - L = 1650m (Pioma II)***

Execution of detailed measurements allowed to determine the noise level they need to stay the personnel operating the conveyor drive Gwarek II (results shown in Table 4). Exposure time used for the calculations at each point was the same because of the continued movement of people into the area. The biggest exceeded by as much as 14.3 [dB], recorded in the area Flow Rate. This has the effect of the remoteness of the security zone from the Flow Rate. Only in the points. XI or 10 [m] sound exposure level, based on a working shift, is normal and is 84.2 [dB]. In determining the safety zone in the opposite direction the situation is almost the same as in the case of the drive Pioma I.

Namely, at the sixth level of the exposure meter is normal and is 82 [dB]. The drive around the sound was recorded at the level of 87,9-90,0 [dB], which gave the average excess of one working shift equal to about 2.2 [dB]. As in the case of output hopper to the storage reservoir so in case of node przesypowego required dimension variation has a significant impact on the level of sound. Big lumps cause a significant increase of kinetic energy, which translates into an increase in acoustic energy. Noteworthy is also one of the additional sources of noise in the area of the test area. At a distance of 30 [m] from the drive Pioma II is a pneumatic pump VOCO, the peak sound level is equal to 121.1 [dB] and is the loudest place on the route of a conveyor belt. Employee resides near the pump less than a minute during the entire

shift, it does not pose too great a risk. Nevertheless, the sound at such a high level tends to reflect on the technical condition of the equipment or accuracy for this measure dewatering the excavation.

## 18.6 Summary and conclusions

Analysis of preliminary tests allowed to determine the level of sound from conveyor haulage Main Content taśmowcych levels in coal mines and identified places where noise is greatest. The largest area includes the noise surrounding the conveyor drive Gwarek Gwarek I and II. Along the route the rest of the main haulage level of the sound was normal or slightly above the legal limit, but only in those parts of ad hoc working crew. In the following detailed research carried out to identify areas in places where the sound pressure is the highest level. The study included 15 specific points of measurement for the drive belt area Gwarek I and 16 points for the drive belt area Gwarek II. Analysis of these studies allowed to determine the safety zone and indicated points where the noise level was the highest:

1. Point I - the drive belt Pioma I - conveyors Gwarek I,
2. Point V - pouring into the reservoir - conveyors Gwarek I,
3. Point VI - przesypowy node on the contact conveyors Gwarek II - Gwarek I.

The studies of noise on the main haulage road there is a need to conduct further analysis to determine the ways to minimize noise in designated areas.

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